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Authors: A. Backman, Ed.      J. Richer                      M. Sporny  
                 Amazon                      Bespoke Engineering      Digital Bazaar

## Signing HTTP Messages

### Abstract

This document describes a mechanism for creating, encoding, and verifying digital signatures or message authentication codes over content within an HTTP message. This mechanism supports use cases where the full HTTP message may not be known to the signer, and where the message may be transformed (e.g., by intermediaries) before reaching the verifier.

This draft is based on draft-cavage-http-signatures-12. The community and the authors have identified several issues with the current text. Additionally, the authors have identified a number of features that are required in order to support additional use cases. In order to preserve continuity with the effort that has been put into draft-cavage-http-signatures-12, this draft maintains normative compatibility with it, and thus does not address these issues or include these features, as doing so requires making backwards-incompatible changes to normative requirements. While such changes are inevitable, the editor recommends that they be driven by working group discussion following adoption of the draft (see Topics for Working Group Discussion). The editor requests that the working group recognize the intent of this initial draft and this recommendation when considering adoption of this draft.

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

### Status of This Memo

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### **1. Introduction**

Message integrity and authenticity are important security properties that are critical to the secure operation of many [HTTP] applications. Application developers typically rely on the transport layer to provide these properties, by operating their application over TLS [RFC8446]. However, TLS only guarantees these properties over a single TLS connection, and the path between client and application may be composed of multiple independent TLS connections (for example, if the application is hosted behind a TLS-terminating gateway or if the client is behind a TLS Inspection appliance). In such cases, TLS cannot guarantee end-to-end message integrity or authenticity between the client and application. Additionally, some operating environments present obstacles that make it impractical to use TLS, or to use features necessary to provide message authenticity. Furthermore, some applications require the binding of an application-level key to the HTTP message, separate from any TLS certificates in use. Consequently, while TLS can meet message integrity and authenticity needs for many HTTP-based applications, it is not a universal solution.

This document defines a mechanism for providing end-to-end integrity and authenticity for content within an HTTP message. The mechanism allows applications to create digital signatures or message authentication codes (MACs) over only that content within the message that is meaningful and appropriate for the application. Strict canonicalization rules ensure that the verifier can verify the signature even if the message has been transformed in any of the many ways permitted by HTTP.

The mechanism described in this document consists of three parts:

- \*A common nomenclature and canonicalization rule set for the different protocol elements and other content within HTTP messages.
- \*Algorithms for generating and verifying signatures over HTTP message content using this nomenclature and rule set.
- \*A mechanism for attaching a signature and related metadata to an HTTP message.

#### **1.1. Requirements Discussion**

HTTP permits and sometimes requires intermediaries to transform messages in a variety of ways. This may result in a recipient

receiving a message that is not bitwise equivalent to the message that was originally sent. In such a case, the recipient will be unable to verify a signature over the raw bytes of the sender's HTTP message, as verifying digital signatures or MACs requires both signer and verifier to have the exact same signed content. Since the raw bytes of the message cannot be relied upon as signed content, the signer and verifier must derive the signed content from their respective versions of the message, via a mechanism that is resilient to safe changes that do not alter the meaning of the message.

For a variety of reasons, it is impractical to strictly define what constitutes a safe change versus an unsafe one. Applications use HTTP in a wide variety of ways, and may disagree on whether a particular piece of information in a message (e.g., the body, or the Date header field) is relevant. Thus a general purpose solution must provide signers with some degree of control over which message content is signed.

HTTP applications may be running in environments that do not provide complete access to or control over HTTP messages (such as a web browser's JavaScript environment), or may be using libraries that abstract away the details of the protocol (such as [the Java HTTPClient library](#)). These applications need to be able to generate and verify signatures despite incomplete knowledge of the HTTP message.

## 1.2. HTTP Message Transformations

As mentioned earlier, HTTP explicitly permits and in some cases requires implementations to transform messages in a variety of ways. Implementations are required to tolerate many of these transformations. What follows is a non-normative and non-exhaustive list of transformations that may occur under HTTP, provided as context:

- \*Re-ordering of header fields with different header field names ([\[HTTP\]](#), [Section 3.2.2](#)).
- \*Combination of header fields with the same field name ([\[HTTP\]](#), [Section 3.2.2](#)).
- \*Removal of header fields listed in the Connection header field ([\[HTTP\]](#), [Section 6.1](#)).
- \*Addition of header fields that indicate control options ([\[HTTP\]](#), [Section 6.1](#)).
- \*Addition or removal of a transfer coding ([\[HTTP\]](#), [Section 5.7.2](#)).

\*Addition of header fields such as Via ([\[HTTP\]](#), [Section 5.7.1](#)) and Forwarded ([\[RFC7239\]](#), [Section 4](#)).

### 1.3. Safe Transformations

Based on the definition of HTTP and the requirements described above, we can identify certain types of transformations that should not prevent signature verification, even when performed on content covered by the signature. The following list describes those transformations:

\*Combination of header fields with the same field name.

\*Reordering of header fields with different names.

\*Conversion between HTTP/1.x and HTTP/2, or vice-versa.

\*Changes in casing (e.g., "Origin" to "origin") of any case-insensitive content such as header field names, request URI scheme, or host.

\*Addition or removal of leading or trailing whitespace to a header field value.

\*Addition or removal of obs-folds.

\*Changes to the request-target and Host header field that when applied together do not result in a change to the message's effective request URI, as defined in [Section 5.5](#) of [\[HTTP\]](#).

Additionally, all changes to content not covered by the signature are considered safe.

### 1.4. Conventions and Terminology

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 [BCP14](#) [\[RFC2119\]](#) [\[RFC8174\]](#) when, and only when, they appear in all capitals, as shown here.

The terms "HTTP message", "HTTP method", "HTTP request", "HTTP response", absolute-form, absolute-path, "effective request URI", "gateway", "header field", "intermediary", request-target, "sender", and "recipient" are used as defined in [\[HTTP\]](#).

For brevity, the term "signature" on its own is used in this document to refer to both digital signatures and keyed MACs. Similarly, the verb "sign" refers to the generation of either a digital signature or keyed MAC over a given input string. The

qualified term "digital signature" refers specifically to the output of an asymmetric cryptographic signing operation.

In addition to those listed above, this document uses the following terms:

**Decimal String**

An Integer String optionally concatenated with a period "." followed by a second Integer String, representing a positive real number expressed in base 10. The first Integer String represents the integral portion of the number, while the optional second Integer String represents the fractional portion of the number. [[ Editor's note: There's got to be a definition for this that we can reference. ]]

**Integer String**

A US-ASCII string of one or more digits "0-9", representing a positive integer in base 10. [[ Editor's note: There's got to be a definition for this that we can reference. ]]

**Signer**

The entity that is generating or has generated an HTTP Message Signature.

**Verifier**

An entity that is verifying or has verified an HTTP Message Signature against an HTTP Message. Note that an HTTP Message Signature may be verified multiple times, potentially by different entities.

This document contains non-normative examples of partial and complete HTTP messages. To improve readability, header fields may be split into multiple lines, using the obs-fold syntax. This syntax is deprecated in [HTTP], and senders **MUST NOT** generate messages that include it.

**2. Identifying and Canonicalizing Content**

In order to allow signers and verifiers to establish which content is covered by a signature, this document defines content identifiers for signature metadata and discrete pieces of message content that may be covered by an HTTP Message Signature.

Some content within HTTP messages may undergo transformations that change the bitwise value without altering meaning of the content (for example, the merging together of header fields with the same name). Message content must therefore be canonicalized before it is signed, to ensure that a signature can be verified despite such innocuous transformations. This document defines rules for each

content identifier that transform the identifier's associated content into such a canonical form.

The following sections define content identifiers, their associated content, and their canonicalization rules.

## 2.1. HTTP Header Fields

An HTTP header field value is identified by its header field name. While HTTP header field names are case-insensitive, implementations **SHOULD** use lowercased field names (e.g., content-type, date, etag) when using them as content identifiers.

An HTTP header field value is canonicalized as follows:

1. Create an ordered list of the field values of each instance of the header field in the message, in the order that they occur (or will occur) in the message.
2. Strip leading and trailing whitespace from each item in the list.
3. Concatenate the list items together, with a comma "," and space " " between each item. The resulting string is the canonicalized value.

### 2.1.1. Canonicalization Examples

This section contains non-normative examples of canonicalized values for header fields, given the following example HTTP message:

```
HTTP/1.1 200 OK
Server: www.example.com
Date: Tue, 07 Jun 2014 20:51:35 GMT
X-OWS-Header:  Leading and trailing whitespace.
X-Obs-Fold-Header: Obsolete
    line folding.
X-Empty-Header:
Cache-Control: max-age=60
Cache-Control:  must-revalidate
```

The following table shows example canonicalized values for header fields, given that message:

Header Field	Canonicalized Value
cache-control	max-age=60, must-revalidate
date	Tue, 07 Jun 2014 20:51:35 GMT



Header Field	Canonicalized Value
server	www.example.com
x-empty-header	
x-obs-fold-header	Obsolete line folding.
x-ows-header	Leading and trailing whitespace.

Table 1: Non-normative examples of header field canonicalization.

## 2.2. Signature Creation Time

The signature's Creation Time ([Section 3.1](#)) is identified by the (created) identifier.

Its canonicalized value is an Integer String containing the signature's Creation Time expressed as the number of seconds since the Epoch, as defined in [Section 4.16](#) of [\[POSIX.1\]](#).

The use of seconds since the Epoch to canonicalize a timestamp simplifies processing and avoids timezone management required by specifications such as [\[RFC3339\]](#).

## 2.3. Signature Expiration Time

The signature's Expiration Time ([Section 3.1](#)) is identified by the (expired) identifier.

Its canonicalized value is a Decimal String containing the signature's Expiration Time expressed as the number of seconds since the Epoch, as defined in [Section 4.16](#) of [\[POSIX.1\]](#).

## 2.4. Target Endpoint

The request target endpoint, consisting of the request method and the path and query of the effective request URI, is identified by the (request-target) identifier.

Its value is canonicalized as follows:

1. Take the lowercased HTTP method of the message.
2. Append a space " ".
3. Append the path and query of the request target of the message, formatted according to the rules defined for the :path pseudo-header in [\[HTTP2\]](#), [Section 8.1.2.3](#). The resulting string is the canonicalized value.

### 2.4.1. Canonicalization Examples

The following table contains non-normative example HTTP messages and their canonicalized (request-target) values.

HTTP Message	(request-target)
POST /?param=value HTTP/1.1 Host: www.example.com	post /?param=value
POST /a/b HTTP/1.1 Host: www.example.com	post /a/b
GET http://www.example.com/a/ HTTP/1.1	get /a/
GET http://www.example.com HTTP/1.1	get /
CONNECT server.example.com:80 HTTP/1.1 Host: server.example.com	connect /
OPTIONS * HTTP/1.1 Host: server.example.com	options *

Table 2: Non-normative examples of (request-target) canonicalization.

### 3. HTTP Message Signatures

An HTTP Message Signature is a signature over a string generated from a subset of the content in an HTTP message and metadata about the signature itself. When successfully verified against an HTTP message, it provides cryptographic proof that with respect to the

subset of content that was signed, the message is semantically equivalent to the message for which the signature was generated.

### 3.1. Signature Metadata

HTTP Message Signatures have metadata properties that provide information regarding the signature's generation and/or verification. The following metadata properties are defined:

#### Algorithm

An HTTP Signature Algorithm defined in the [HTTP Signature Algorithms Registry](#) defined in this document. It describes the signing and verification algorithms for the signature.

#### Creation Time

A timestamp representing the point in time that the signature was generated. Sub-second precision is not supported. A signature's Creation Time **MAY** be undefined, indicating that it is unknown.

#### Covered Content

An ordered list of content identifiers ([Section 2](#)) that indicates the metadata and message content that is covered by the signature. The order of identifiers in this list affects signature generation and verification, and therefore **MUST** be preserved.

#### Expiration Time

A timestamp representing the point in time at which the signature expires. An expired signature always fails verification. A signature's Expiration Time **MAY** be undefined, indicating that the signature does not expire.

#### Verification Key Material

The key material required to verify the signature.

### 3.2. Creating a Signature

In order to create a signature, a signer completes the following process:

1. Choose key material and algorithm, and set metadata properties ([Section 3.2.1](#))
2. Create the Signature Input ([Section 3.2.2](#))
3. Sign the Signature Input ([Section 3.2.3](#))

The following sections describe each of these steps in detail.

### 3.2.1. Choose and Set Signature Metadata Properties

1. The signer chooses an HTTP Signature Algorithm from those registered in the [HTTP Signature Algorithms Registry](#) defined by this document, and sets the signature's Algorithm property to that value. The signer **MUST NOT** choose an algorithm marked "Deprecated". The mechanism by which the signer chooses an algorithm is out of scope for this document.
2. The signer chooses key material to use for signing and verification, and sets the signature's Verification Key Material property to the key material required for verification. The signer **MUST** choose key material that is appropriate for the signature's Algorithm, and that conforms to any requirements defined by the Algorithm, such as key size or format. The mechanism by which the signer chooses key material is out of scope for this document.
3. The signer sets the signature's Creation Time property to the current time.
4. The signer sets the signature's Expiration Time property to the time at which the signature is to expire, or to undefined if the signature will not expire.
5. The signer creates an ordered list of content identifiers representing the message content and signature metadata to be covered by the signature, and assigns this list as the signature's Covered Content. Each identifier **MUST** be one of those defined in [Section 2](#). This list **MUST NOT** be empty, as this would result in creating a signature over the empty string.

If the signature's Algorithm name does not start with rsa, hmac, or ecdsa, signers **SHOULD** include (created) and (request-target) in the list.

If the signature's Algorithm starts with rsa, hmac, or ecdsa, signers **SHOULD** include date and (request-target) in the list.

Further guidance on what to include in this list and in what order is out of scope for this document. However, the list order is significant and once established for a given signature it **MUST** be preserved for that signature.

For example, given the following HTTP message:

```
GET /foo HTTP/1.1
Host: example.org
Date: Tue, 07 Jun 2014 20:51:35 GMT
X-Example: Example header
           with some whitespace.
X-EmptyHeader:
Cache-Control: max-age=60
Cache-Control: must-revalidate
```

The following table presents a non-normative example of metadata values that a signer may choose:

Property	Value
Algorithm	rsa-256
Covered Content	(request-target), (created), host, date, cache-control, x-emptyheader, x-example
Creation Time	Equal to the value specified in the Date header field.
Expiration Time	Equal to the Creation Time plus five minutes.
Verification Key Material	The public key provided in <a href="#">Appendix A.1.1</a> and identified by the keyId value "test-key-b".

Table 3: Non-normative example metadata values

### 3.2.2. Create the Signature Input

The Signature Input is a US-ASCII string containing the content that will be signed. To create it, the signer concatenates together entries for each identifier in the signature's Covered Content in the order it occurs in the list, with each entry separated by a newline "\n". An identifier's entry is a US-ASCII string consisting of the lowercased identifier followed with a colon ":", a space " ", and the identifier's canonicalized value (described below).

If Covered Content contains (created) and the signature's Creation Time is undefined or the signature's Algorithm name starts with rsa, hmac, or ecDSA an implementation **MUST** produce an error.

If Covered Content contains (expires) and the signature does not have an Expiration Time or the signature's Algorithm name starts with rsa, hmac, or ecDSA an implementation **MUST** produce an error.

If Covered Content contains an identifier for a header field that is not present or malformed in the message, the implementation **MUST** produce an error.

For the non-normative example Signature metadata in [Table 3](#), the corresponding Signature Input is:

```
(request-target): get /foo
(created): 1402170695
host: example.org
date: Tue, 07 Jun 2014 20:51:35 GMT
cache-control: max-age=60, must-revalidate
x-emptyheader:
x-example: Example header with some whitespace.
```

Figure 1: Non-normative example Signature Input

### 3.2.3. Sign the Signature Input

The signer signs the Signature Input using the signing algorithm described by the signature's Algorithm property, and the key material chosen by the signer. The signer then encodes the result of that operation as a base 64-encoded string [[RFC4648](#)]. This string is the signature value.

For the non-normative example Signature metadata in [Section 3.2.1](#) and Signature Input in [Figure 1](#), the corresponding signature value is:

```
T1l3tWH2cSP31nfuv3nVaHQ6IAu9YLEXg2pCeE0JETXnlWbgKtBTaXV6LNQWtf4042V2
DZwDZbmVZ8xW3TFW80RrfrY0+fyjD40LN7/zV6L6d2v7uBpuWZ8QzKuHYFaRNVXgFBXN3
VJnsIOUjv20pqZMK03phLCKX2/zQzJLCBQvF/5UKtnJiMp1ACNhG8LF0Q0FPWfe86YZBB
xqrQr5WfjMu0L0052ZAXi9KTWSlceJ2U361gDb7S5Deub8MaDrjUEpluphQeo8xyvHBoN
Xsqeax/WaHyRY0gaW6krxEGVaBQAfA2czYZhEA05Tb38ahq/gwDQ1bagd9rGnCHtAg==
```

Figure 2: Non-normative example signature value

### 3.3. Verifying a Signature

In order to verify a signature, a verifier **MUST**:

1. Examine the signature's metadata to confirm that the signature meets the requirements described in this document, as well as any additional requirements defined by the application such as which header fields or other content are required to be covered by the signature.
2. Use the received HTTP message and the signature's metadata to recreate the Signature Input, using the process described in [Section 3.2.2](#).

3. Use the signature's Algorithm and Verification Key Material with the recreated Signing Input to verify the signature value.

A signature with a Creation Time that is in the future or an Expiration Time that is in the past **MUST NOT** be processed.

The verifier **MUST** ensure that a signature's Algorithm is appropriate for the key material the verifier will use to verify the signature. If the Algorithm is not appropriate for the key material (for example, if it is the wrong size, or in the wrong format), the signature **MUST NOT** be processed.

### 3.3.1. Enforcing Application Requirements

The verification requirements specified in this document are intended as a baseline set of restrictions that are generally applicable to all use cases. Applications using HTTP Message Signatures **MAY** impose requirements above and beyond those specified by this document, as appropriate for their use case.

Some non-normative examples of additional requirements an application might define are:

- \*Requiring a specific set of header fields to be signed (e.g., Authorization, Digest).

- \*Enforcing a maximum signature age.

- \*Prohibiting the use of certain algorithms, or mandating the use of an algorithm.

- \*Requiring keys to be of a certain size (e.g., 2048 bits vs. 1024 bits).

Application-specific requirements are expected and encouraged. When an application defines additional requirements, it **MUST** enforce them during the signature verification process, and signature verification **MUST** fail if the signature does not conform to the application's requirements.

Applications **MUST** enforce the requirements defined in this document. Regardless of use case, applications **MUST NOT** accept signatures that do not conform to these requirements.

## 4. The 'Signature' HTTP Header

The "Signature" HTTP header provides a mechanism to attach a signature to the HTTP message from which it was generated. The header field name is "Signature" and its value is a list of parameters and values, formatted according to the signature syntax

defined below, using the extended Augmented Backus-Naur Form (ABNF) notation used in [[HTTP](#)].

signature = #( sig-param )

sig-param = token BWS "=" BWS ( token / quoted-string )

Each sig-param is the name of a parameter defined in the [Section 5.2](#) defined in this document. The initial contents of this registry are described in [Section 4.1](#).

#### 4.1. Signature Header Parameters

The Signature header's parameters contain the signature value itself and the signature metadata properties required to verify the signature. Unless otherwise specified, parameters **MUST NOT** occur multiple times in one header, whether with the same or different values. The following parameters are defined:

##### algorithm

**RECOMMENDED.** The algorithm parameter contains the name of the signature's Algorithm, as registered in the [HTTP Signature Algorithms Registry](#) defined by this document. Verifiers **MUST** determine the signature's Algorithm from the keyId parameter rather than from algorithm. If algorithm is provided and differs from or is incompatible with the algorithm or key material identified by keyId (for example, algorithm has a value of rsa-sha256 but keyId identifies an EdDSA key), then implementations **MUST** produce an error. Implementers should note that previous versions of this specification determined the signature's Algorithm using the algorithm parameter only, and thus could be utilized by attackers to expose security vulnerabilities. The default value for this parameter is "hs2019".

##### created

**RECOMMENDED.** The created parameter contains the signature's Creation Time, expressed as the canonicalized value of the (created) content identifier, as defined in [Section 2](#). If not specified, the signature's Creation Time is undefined. This parameter is useful when signers are not capable of controlling the Date HTTP Header such as when operating in certain web browser environments.

##### expires

**OPTIONAL.** The expires parameter contains the signature's Expiration Time, expressed as the canonicalized value of the (expires) content identifier, as defined in [Section 2](#). If the signature does not have an Expiration Time, this parameter **MUST**



be omitted. If not specified, the signature's Expiration Time is undefined.

#### headers

**OPTIONAL.** The headers parameter contains the signature's Covered Content, expressed as a string containing a quoted list of the identifiers in the list, in the order they occur in the list, with a space " " between each identifier. If specified, identifiers for header fields **SHOULD** be lowercased and all others **MUST** be lowercased. The default value for this parameter is "(created)".

#### keyId

**REQUIRED.** The keyId parameter is a US-ASCII string whose value can be used by a verifier to identify and/or obtain the signature's Verification Key Material. The format and semantics of this value are out of scope for this document.

#### signature

**REQUIRED.** The signature parameter contains the signature value, as described in [Section 3.2.3](#).

### 4.2. Example

The following is a non-normative example Signature header field representing the signature in [Figure 2](#):

```
Signature: keyId="test-key-b", algorithm="rsa-sha256",
created=1402170695, expires=1402170995,
headers="(request-target) (created) host date cache-control
x-emptyheader x-example",
signature="T1l3tWH2cSP31nfuvvc3nVaHQ6IAu9YLEXg2pCeEOJETXnlWbgKtBTa
XV6LNQWtf4042V2DZwDZbmVZ8xW3TFW80RrfrY0+fyjD40LN7/zV6L6d2v7uB
puWZ8QzKuHYFaRNVXgFBXN3VJnsIOUjv20pqZMK03phLCKX2/zQzJLCBQvF/5
UKtnJiMp1ACNhG8LF0Q0FPWfe86YZBBxqrQr5WfjMu0L0052ZAxI9KTWSlceJ
2U361gDb7S5Deub8MaDrjUEpluphQeo8xyvHBoNXsqaax/WaHyRYOgaW6krxE
GVaBQAfA2czYZhEA05Tb38ahq/gwDQ1bagd9rGnCHtAg=="
```

## 5. IANA Considerations

### 5.1. HTTP Signature Algorithms Registry

This document defines HTTP Signature Algorithms, for which IANA is asked to create and maintain a new registry titled "HTTP Signature Algorithms". Initial values for this registry are given in [Section 5.1.2](#). Future assignments and modifications to existing assignment are to be made through the Expert Review registration policy [[BCP 26](#)] and shall follow the template presented in [Section 5.1.1](#).

### 5.1.1. Registration Template

#### Algorithm Name

An identifier for the HTTP Signature Algorithm. The name **MUST** be an ASCII string consisting only of lower-case characters ("a" - "z"), digits ("0" - "9"), and hyphens ("-"), and **SHOULD NOT** exceed 20 characters in length. The identifier **MUST** be unique within the context of the registry.

#### Status

A brief text description of the status of the algorithm. The description **MUST** begin with one of "Active" or "Deprecated", and **MAY** provide further context or explanation as to the reason for the status.

#### Description

A description of the algorithm used to sign the signing string when generating an HTTP Message Signature, or instructions on how to determine that algorithm. When the description specifies an algorithm, it **MUST** include a reference to the document or documents that define the algorithm.

### 5.1.2. Initial Contents

[[ MS: The references in this section are problematic as many of the specifications that they refer to are too implementation specific, rather than just pointing to the proper signature and hashing specifications. A better approach might be just specifying the signature and hashing function specifications, leaving implementers to connect the dots (which are not that hard to connect). ]]

#### hs2019

##### Algorithm Name

hs2019

##### Status

active

##### Description

Derived from metadata associated with keyId. Recommend support for:

\*RSASSA-PSS [[RFC8017](#)] using SHA-512 [[RFC6234](#)]

\*HMAC [[RFC2104](#)] using SHA-512 [[RFC6234](#)]

\*ECDSA using curve P-256 [[DSS](#)] and SHA-512 [[RFC6234](#)]

\*Ed25519ph, Ed25519ctx, and Ed25519 [[RFC8032](#)]

## rsa-sha1

**Algorithm Name**

rsa-sha1

**Status**

Deprecated; SHA-1 not secure.

**Description**

RSASSA-PKCS1-v1\_5 [[RFC8017](#)] using SHA-1 [[RFC6234](#)]

## rsa-sha256

**Algorithm Name**

rsa-sha256

**Status**

Deprecated; specifying signature algorithm enables attack vector.

**Description**

RSASSA-PKCS1-v1\_5 [[RFC8017](#)] using SHA-256 [[RFC6234](#)]

## hmac-sha256

**Algorithm Name**

hmac-sha256

**Status**

Deprecated; specifying signature algorithm enables attack vector.

**Description**

HMAC [[RFC2104](#)] using SHA-256 [[RFC6234](#)]

## ecdsa-sha256

**Algorithm Name**

ecdsa-sha256

**Status**

Deprecated; specifying signature algorithm enables attack vector.

**Description**

ECDSA using curve P-256 [[DSS](#)] and SHA-256 [[RFC6234](#)]

## 5.2. HTTP Signature Parameters Registry

This document defines the Signature header field, whose value contains a list of named parameters. IANA is asked to create and maintain a new registry titled "HTTP Signature Parameters" to record and maintain the set of named parameters defined for use within the

Signature header field. Initial values for this registry are given in [Section 5.2.2](#). Future assignments and modifications to existing assignment are to be made through the Expert Review registration policy [[BCP 26](#)] and shall follow the template presented in [Section 5.2.1](#).

### 5.2.1. Registration Template

#### Name

An identifier for the parameter. The name **MUST** be an ASCII string consisting only of lower-case characters ("a" - "z"), digits ("0" - "9"), and hyphens ("-"), and **SHOULD NOT** exceed 20 characters in length. The identifier **MUST** be unique within the context of the registry.

#### Status

A value indicating the status of the parameter definition. Allowed values are "Active" and "Deprecated". Active parameter definitions are available for general use. Deprecated parameter definitions may be in use by existing implementations, but **SHOULD NOT** be used by new implementations.

#### Reference(s)

A reference or list of references to the documents that define the purpose, content, and usage of the parameter. The parameter definition **MUST** define the format of the parameter's value using the extended ABNF notation used in [[HTTP](#)], or by referencing one or more standard formats such as base 64 or URI. The parameter definition **MUST** also specify the normative requirements for when and how the parameter may be used. Value formats **MUST NOT** allow values that would break the parameter list syntax used by the Signature header.

### 5.2.2. Initial Contents

The table below contains the initial contents of the HTTP Signature Parameters Registry. Each row in the table represents a distinct entry in the registry.

Name	Status	Reference(s)
algorithm	Active	<a href="#">Section 4.1</a> of this document
created	Active	<a href="#">Section 4.1</a> of this document
expires	Active	<a href="#">Section 4.1</a> of this document
headers	Active	<a href="#">Section 4.1</a> of this document
keyId	Active	<a href="#">Section 4.1</a> of this document
signature	Active	<a href="#">Section 4.1</a> of this document

Table 4: Initial contents of the HTTP Signature Parameters Registry.

## 6. Security Considerations

[[ TODO: need to dive deeper on this section; not sure how much of what's referenced below is actually applicable, or if it covers everything we need to worry about. ]]

[[ TODO: Should provide some recommendations on how to determine what content needs to be signed for a given use case. ]]

There are a number of security considerations to take into account when implementing or utilizing this specification. A thorough security analysis of this protocol, including its strengths and weaknesses, can be found in Security Considerations for HTTP Signatures [WP-HTTP-Sig-Audit].

## 7. References

### 7.1. Normative References

- [BCP 26] Cotton, M., Leiba, B., and T. Narten, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 8126, DOI 10.17487/RFC8126, June 2017, <<https://www.rfc-editor.org/info/rfc8126>>.
- [DSS] NIST, "Digital Signature Standard (DSS)", FIPS 186-4, DOI 10.6028/NIST.FIPS.186-4, July 2013, <<https://csrc.nist.gov/publications/detail/fips/186/4/final>>.
- [HTTP] Fielding, R., Ed. and J. Reschke, Ed., "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing", RFC 7230, DOI 10.17487/RFC7230, June 2014, <<https://www.rfc-editor.org/info/rfc7230>>.
- [HTTP2] Belshé, M., Peon, R., and M. Thomson, Ed., "Hypertext Transfer Protocol Version 2 (HTTP/2)", RFC 7540, DOI 10.17487/RFC7540, May 2015, <<https://www.rfc-editor.org/info/rfc7540>>.
- [POSIX.1] IEEE and The Open Group, "The Open Group Base Specifications Issue 7, 2018 edition", IEEE Std 1003.1-2017, 2018, <<https://pubs.opengroup.org/onlinepubs/9699919799/>>.
- [RFC2104] Krawczyk, H., Bellare, M., and R. Canetti, "HMAC: Keyed-Hashing for Message Authentication", RFC 2104, DOI 10.17487/RFC2104, February 1997, <<https://www.rfc-editor.org/info/rfc2104>>.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/

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- [RFC3986] Berners-Lee, T., Fielding, R., and L. Masinter, "Uniform Resource Identifier (URI): Generic Syntax", STD 66, RFC 3986, DOI 10.17487/RFC3986, January 2005, <<https://www.rfc-editor.org/info/rfc3986>>.
- [RFC4648] Josefsson, S., "The Base16, Base32, and Base64 Data Encodings", RFC 4648, DOI 10.17487/RFC4648, October 2006, <<https://www.rfc-editor.org/info/rfc4648>>.
- [RFC7541] Peon, R. and H. Ruellan, "HPACK: Header Compression for HTTP/2", RFC 7541, DOI 10.17487/RFC7541, May 2015, <<https://www.rfc-editor.org/info/rfc7541>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.

## 7.2. Informative References

- [RFC3339] Klyne, G. and C. Newman, "Date and Time on the Internet: Timestamps", RFC 3339, DOI 10.17487/RFC3339, July 2002, <<https://www.rfc-editor.org/info/rfc3339>>.
- [RFC6234] Eastlake 3rd, D. and T. Hansen, "US Secure Hash Algorithms (SHA and SHA-based HMAC and HKDF)", RFC 6234, DOI 10.17487/RFC6234, May 2011, <<https://www.rfc-editor.org/info/rfc6234>>.
- [RFC7239] Petersson, A. and M. Nilsson, "Forwarded HTTP Extension", RFC 7239, DOI 10.17487/RFC7239, June 2014, <<https://www.rfc-editor.org/info/rfc7239>>.
- [RFC7518] Jones, M., "JSON Web Algorithms (JWA)", RFC 7518, DOI 10.17487/RFC7518, May 2015, <<https://www.rfc-editor.org/info/rfc7518>>.
- [RFC8017] Moriarty, K., Ed., Kaliski, B., Jonsson, J., and A. Rusch, "PKCS #1: RSA Cryptography Specifications Version 2.2", RFC 8017, DOI 10.17487/RFC8017, November 2016, <<https://www.rfc-editor.org/info/rfc8017>>.
- [RFC8032] Josefsson, S. and I. Liusvaara, "Edwards-Curve Digital Signature Algorithm (EdDSA)", RFC 8032, DOI 10.17487/

RFC8032, January 2017, <<https://www.rfc-editor.org/info/rfc8032>>.

[RFC8446] Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", RFC 8446, DOI 10.17487/RFC8446, August 2018, <<https://www.rfc-editor.org/info/rfc8446>>.

[WP-HTTP-Sig-Audit] Sporny, M., "Security Considerations for HTTP Signatures", June 2013, <<https://web-payments.org/specs/source/http-signatures-audit/>>.

## Appendix A. Examples

### A.1. Example Keys

This section provides cryptographic keys that are referenced in example signatures throughout this document. These keys **MUST NOT** be used for any purpose other than testing.

#### A.1.1. rsa-test

The following key is a 2048-bit RSA public and private key pair:

```
-----BEGIN RSA PUBLIC KEY-----
MIIBCgKCAQEAhAKYdtoeoy8zcAcR874L8cnZxKzAGwd7v36App7Pv6Q2jdsPBRrw
WEBnez6d0UDKDwGbc6nxfEXAy5mbhgajzrw3M0Et8uA5txSKobBpKDeBL0sdJKFq
MgmXCQVEG7YemcxDTRPxAleIAgYYRjTsd/QBwVW90wNFhekro3RtlinV0a75jfZg
kne/YiktSvLG34lw2zqXBDTC5NHR0UqGT1ML4P1NZS5Ri2U4aCNx2rUPRcKIIE0P
uKxI4T+HIaFpv8+rdV6eUgOrB2xeI1dSFFn/nnv50oZJEIB+VmuKn3DCUcCZSF1Q
PSXSfBDiUGhwOw76WuSSsf1D4b/vLoJ10wIDAQAB
-----END RSA PUBLIC KEY-----
```

```
-----BEGIN RSA PRIVATE KEY-----
MIIEqAIBAACAQEAhAKYdtoeoy8zcAcR874L8cnZxKzAGwd7v36App7Pv6Q2jdsP
BRrwWEBnez6d0UDKDwGbc6nxfEXAy5mbhgajzrw3M0Et8uA5txSKobBpKDeBL0sd
JKFqMgmXCQVEG7YemcxDTRPxAleIAgYYRjTsd/QBwVW90wNFhekro3RtlinV0a75
jfZgkne/YiktSvLG34lw2zqXBDTC5NHR0UqGT1ML4P1NZS5Ri2U4aCNx2rUPRcKI
IE0PuKxI4T+HIaFpv8+rdV6eUgOrB2xeI1dSFFn/nnv50oZJEIB+VmuKn3DCUcCZ
SF1QPSXSfBDiUGhwOw76WuSSsf1D4b/vLoJ10wIDAQABAoIBAG/JZuSwdoVHbi56
vjgCgkjg3lk01Kr03nrdm6nrgA9P9qaPjxuKoWaK01cBQ1E1pSwp/cKncYgD5WxE
CpAnRUXG2pG4zdkzCYzAh1i+c34L6oZoHsirK6oNcEnHveydfzJL5934egm6p8DW
+m1RQ70yUt4uRc0YSor+q1LGJvGQHReF0WmJBZhrh5e63Pq71E0gIwuBqL8SMaA
yRXtK+JGxZpImTq+NHvEWWCu09SCq0r838ceQI55SvzmTkwtC+8AT2zFviMzkkR
Qo6SPsrqItxZWRty2izawTF0Bf5S2Vax70+6t3wBsQ1sLptoSgX3Qb1ELY5asI0J
YFz7LJECgYkAsqeUJmqXE3LP8tYoIjMIAKiTm9o6psPlc8CrLI9CH0UbuA2JCOM
cCNq8SyYbTqgnW1B9ZfcAm/cFpA8tYci9m5vYK8HNxQr+8FS3Qo8N9RJ8d0U5Csw
DzMYfRghAfUGwm1Wj5hp1pQzAuhwb0XFtxKHVsMPHz1IBtF9Y8jvqqgYHLbmyiu1
mwJ5AL0pYF0G7x81pr1ARURwHo0Yf52kEw1dpxp+JXER7hQRWQki5/NsUetv+8RT
qn2m6qte5DXLyn83b1qRscSdnCCwKtKWUug5q2ZbwVOCJctmRwmnP1311WRYfj67
B/xJ1ZA6X3GEf4sNRenAtaucPEelgR2nsN0gKQKBiGoqHwBk1qYvBxX2X3kbPDkv
9C+celgZd2PW7aYLCHq7nPBmfDV0yHcwj0hXZ8jRMjMANVR/eLQ2EfsRLdW69bn
f3ZD7JS1fwGn03exGmH03HZG+6AvberKYVYNHahNFEw5TsAcQWDLRpkGybBcxqZo
81YCqlqidwfe05Ytl07etx1xLyqa2NsCeG9A86Ujg+aeNnXEIDk1PDK+EuithIUa
/2IxKzJKw11BKr2d4xAfR0ZnEYuRrbeDQYgTI0lfW6/GuYIxKYgEKCFFHfJATAG
IxHrq1PD0iSwXd2GmVVyYEmhZnbcP8CxaEMQoevxAta0ssMK3w6UsDtVuvYvF22m
qQKBiD5GwESzsfPy3Ga0MvZpn3D6EJQLgsnrUPZx+z2Ep2x0xc5orneB5fGyF1P
WtP+fG5Q6Dpdz3LRfm+KwBCWFKQjg7uTxcjerhBWEYPmEMKYwTJF5PBG9/ddvHLQ
EQeNC8fHGg4UXU8mhHnSBt3EA10qQJfRds15M38eG2cYwB1PZpDHScDnDA0=
-----END RSA PRIVATE KEY-----
```

## A.2. Example keyId Values

The table below maps example keyId values to associated algorithms and/or keys. These are example mappings that are valid only within the context of examples in examples within this and future documents that reference this section. Unless otherwise specified, within the context of examples it should be assumed that the signer and verifier understand these keyId mappings. These keyId values are not reserved, and deployments are free to use them, with these associations or others.



keyId	Algorithm	Verification Key
test-key-a	hs2019, using RSASSA-PSS [RFC8017] and SHA-512 [RFC6234]	The public key specified in <a href="#">Appendix A.1.1</a> .
test-key-b	rsa-256	The public key specified in <a href="#">Appendix A.1.1</a> .

Table 5

### A.3. Test Cases

This section provides non-normative examples that may be used as test cases to validate implementation correctness. These examples are based on the following HTTP message:

```
POST /foo?param=value&pet=dog HTTP/1.1
Host: example.com
Date: Tue, 07 Jun 2014 20:51:35 GMT
Content-Type: application/json
Digest: SHA-256=X48E9q0okqrvdts8n0JRJN30WDUoyWxBf7kbu9DBPE=
Content-Length: 18
```

```
{"hello": "world"}
```

#### A.3.1. Signature Generation

##### A.3.1.1. hs2019 signature over minimal recommended content

This presents metadata for a Signature using hs2019, over minimum recommended data to sign:

Property	Value
Algorithm	hs2019, using RSASSA-PSS [RFC8017] using SHA-512 [RFC6234]
Covered Content	(created) (request-target)
Creation Time	8:51:35 PM GMT, June 7th, 2014
Expiration Time	Undefined
Verification Key Material	The public key specified in <a href="#">Appendix A.1.1</a> .

Table 6

The Signature Input is:

```
(created): 1402170695
(request-target): post /foo?param=value&pet=dog
```

The signature value is:

e3y37nxAoeuXw2KbaIxE2d9jpE7Z9okgizg6QbD2Z7fUVUvog+ZTKKLRBnhNg1VIY6fAaYlHwx7ZAXXdBVF8gjWBPL6U9zRrB4PFzjoLSxHaqsvS0ZK9FRxpenptgukaVQ1aeva3PE1aD6zZ93df2lFIFXGDefYCQ+M/SrDGQOFvaVyKekte5m06zQZ/HpokjMKvilfSMJS+vbvC1GJIItQpjs636Db+7zB2W1BurkGxtQdCLDXuIDg4S8pPSDihkch/dUzL2BpML3PXGKVXwHOUkVG6Q2ge07IYdzya6N1fIVA9eKI1Y47HT35QliVAXZgE0EZLo8mxq19ReIVvuFg==

A possible Signature header for this signature is:

Signature: keyId="test-key-a", created=1402170695,  
headers="(created) (request-target)",  
signature="e3y37nxAoeuXw2KbaIxE2d9jpE7Z9okgizg6QbD2Z7fUVUvog+ZTKKLRBnhNg1VIY6fAaYlHwx7ZAXXdBVF8gjWBPL6U9zRrB4PFzjoLSxHaqsvS0ZK9FRxpenptgukaVQ1aeva3PE1aD6zZ93df2lFIFXGDefYCQ+M/SrDGQOFvaVyKekte5m06zQZ/HpokjMKvilfSMJS+vbvC1GJIItQpjs636Db+7zB2W1BurkGxtQdCLDXuIDg4S8pPSDihkch/dUzL2BpML3PXGKVXwHOUkVG6Q2ge07IYdzya6N1fIVA9eKI1Y47HT35QliVAXZgE0EZLo8mxq19ReIVvuFg=="

#### A.3.1.2. hs2019 signature covering all header fields

This presents metadata for a Signature using hs2019 that covers all header fields in the request:

Property	Value
Algorithm	hs2019, using RSASSA-PSS [RFC8017] using SHA-512 [RFC6234]
Covered Content	(created), (request-target), host, date, content-type, digest, content-length
Creation Time	8:51:35 PM GMT, June 7th, 2014
Expiration Time	Undefined
Verification Key Material	The public key specified in <a href="#">Appendix A.1.1</a> .

Table 7

The Signature Input is:

(created): 1402170695  
(request-target): post /foo?param=value&pet=dog  
host: example.com  
date: Tue, 07 Jun 2014 20:51:35 GMT  
content-type: application/json  
digest: SHA-256=X48E9q0okqrvdts8n0JRJN30WDUoywXBf7kbu9DBPE=  
content-length: 18

The signature value is:

```
KXUj1H3Z0hv3Nk4x1RLTn4b0M1M0mFiud3VXrMa9MaLCxnVmrq0X5Bu1RvB65YW/wQp0oT/nNQpXg0YeY8ovmH1pkRyz5buNDqo0pRsCpLGxsIJ9cX8XVsM9jy+Q1+RI1D9wfWoPHh  
qhoXt35ZkasuIDPF/AETu0bs9QydlSq0NwbK+TdQguDK/8Va1Poc16wK1uLwqcX1xhPEb  
55EmdYB9pddDyHTADING7K4qMwof2mC3t8Pb0yoLZoZX5a40r4FrCCKK/9BHAhq/RsVk0  
dTENMbTB4i7cHvKQu+o9xuYWuxyvBa0Z6Nd0b0di70cdrSDEsL5Gz7LBY5J2N9KdGg==
```

A possible Signature header for this signature is:

```
Signature: keyId="test-key-a", algorithm="hs2019",  
created=1402170695,  
headers="(request-target) (created) host date content-type digest  
content-length",  
signature="KXUj1H3Z0hv3Nk4x1RLTn4b0M1M0mFiud3VXrMa9MaLCxnVmrq0X5B  
u1RvB65YW/wQp0oT/nNQpXg0YeY8ovmH1pkRyz5buNDqo0pRsCpLGxsIJ9cX8  
XVsM9jy+Q1+RI1D9wfWoPHh  
qhoXt35ZkasuIDPF/AETu0bs9QydlSq0NwbK+T  
dQguDK/8Va1Poc16wK1uLwqcX1xhPEb55EmdYB9pddDyHTADING7K4qMwof2m  
C3t8Pb0yoLZoZX5a40r4FrCCKK/9BHAhq/RsVk0dTENMbTB4i7cHvKQu+o9xu  
YWuxyvBa0Z6Nd0b0di70cdrSDEsL5Gz7LBY5J2N9KdGg=="
```

### A.3.2. Signature Verification

#### A.3.2.1. Minimal Required Signature Header

This presents a Signature header containing only the minimal required parameters:

```
Signature: keyId="test-key-a", (created): 1402170695,  
signature="V3SijFpJ0vDUT8t1/EnYli/4TbF2AGqwBGiGUGrgClCki0AIl0xxY7  
2Mr13DccFkYzq3gX1jI0pKXzH70C5bru4b71SBG+ShiJLu34gHCG33iw44NLG  
UVT5+F+LCKbbHberyk8eyYsZ+TLwtZAYKafxfN0WQXF4o3QaWs1DmM8Tcgrd8  
onM45ayFyR4nXRlcGad4PISYGz8Pm04Y+K8RY0yDkgsRmRkftFQUYG41anyE  
lccNLfEfLBKsyV6kxr36U1Q7FdUopLv8kqluQySrWD6kesvFxnVbE0i+1uZqT  
uFlK8ZldITQiqtNYaabRjQFZio63gma2y+UAaTGLdM9A=="
```

The corresponding signature metadata derived from this header field is:

Property	Value
Algorithm	hs2019, using RSASSA-PSS [RFC8017] using SHA-256 [RFC6234]
Covered Content	(created)
Creation Time	8:51:35 PM GMT, June 7th, 2014

Property	Value
Expiration Time	Undefined
Verification Key Material	The public key specified in <a href="#">Appendix A.1.1</a> .

Table 8

The corresponding Signature Input is:

(created): 1402170695

### A.3.2.2. Minimal Recommended Signature Header

This presents a Signature header containing only the minimal required and recommended parameters:

```
Signature: algorithm="hs2019", keyId="test-key-a",
  (created): 1402170695,
  signature="V3SijFpJ0vDUT8t1/EnYli/4TbF2AGqwBGiGUGrgClCki0AI10xxY7
    2Mr13DccFkYzg3gX1jI0pKXzH70C5bru4b71SBG+ShiJLu34gHCG33iw44NLG
    UVt5+F+LCKbbHberyk8eyYsZ+TLwtZAYKafxfnOWQXF4o3Qaws1DMm8Tcgrd8
    onM45ayFyR4nXRlcGad4PISYGz8Pm04Y+K8RY0yDkgsMRxKtftFQUYG41anyE
    lccNlfEfLBKsyV6kxr36U1Q7FdUopLv8kqluQySrWD6kesvFxNvbEOi+1uZqT
    uFlk8ZldITQiqtNYaabRjQFZio63gma2y+UAaTGLdM9A=="
```

The corresponding signature metadata derived from this header field is:

Property	Value
Algorithm	hs2019, using RSASSA-PSS [ <a href="#">RFC8017</a> ] using SHA-512 [ <a href="#">RFC6234</a> ]
Covered Content	(created)
Creation Time	8:51:35 PM GMT, June 7th, 2014
Expiration Time	Undefined
Verification Key Material	The public key specified in <a href="#">Appendix A.1.1</a> .

Table 9

The corresponding Signature Input is:

(created): 1402170695

### A.3.2.3. Minimal Signature Header using rsa-256

This presents a minimal Signature header for a signature using the rsa-256 algorithm:

```
Signature: algorithm="rsa-256", keyId="test-key-b",
  headers="date",
  signature="HtXycC197RBVki66ADKnC9c5eSS1b57GnQ4KFqNZpl0pNfxqk62Jz
  Z484jXgLv0TRaKfR4hwyx1cyb+BwkVasApQovBSdit9Ml/YmN2IvJDPncr1h
  PDVDv36Z9/DiS0+RNHD7iLXugdXo1+MGRimW1RmYdenl/ITeb7rjfLZ4b9VnN
  LFtVwvrjhAiwIqeLjodVImzVc5srrk19HMZNuUejK6I3/MyN3+3U8tIRW4LWz
  x6ZgGZUaEEP0aBlBkt7Fj0Tt5/P5HNW/Sa/m8smxb0HnwzAJDa10PyjzdIbyw
  lnWIIwtZKPPsoVoKVopUWEU3TNhpWmaVhFrUL/O6SN3w=="
```

The corresponding signature metadata derived from this header field is:

Property	Value
Algorithm	rsa-256
Covered Content	date
Creation Time	Undefined
Expiration Time	Undefined
Verification Key Material	The public key specified in <a href="#">Appendix A.1.1</a> .

Table 10

The corresponding Signature Input is:

date: Tue, 07 Jun 2014 20:51:35 GMT

### Appendix B. Topics for Working Group Discussion

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

The goal of this draft document is to provide a starting point at feature parity and compatible with the cavage-12 draft. The draft has known issues that will need to be addressed during development, and in the spirit of keeping compatibility, these issues have been enumerated but not addressed in this version. The editor recommends the working group discuss the issues and features described in this section after adoption of the document by the working group. Topics are not listed in any particular order.

## **B.1. Issues**

### **B.1.1. Confusing guidance on algorithm and key identification**

The current draft encourages determining the Algorithm metadata property from the keyId field, both in the guidance for the use of algorithm and keyId, and the definition for the hs2019 algorithm and deprecation of the other algorithms in the registry. The current state arose from concern that a malicious party could change the value of the algorithm parameter, potentially tricking the verifier into accepting a signature that would not have been verified under the actual parameter.

Punting algorithm identification into keyId hurts interoperability, since we aren't defining the syntax or semantics of keyId. It actually goes against that claim, as we are dictating that the signing algorithm must be specified by keyId or derivable from it. It also renders the algorithm registry essentially useless. Instead of this approach, we can protect against manipulation of the Signature header field by adding support for (and possibly mandating) including Signature metadata within the Signature Input.

### **B.1.2. Lack of definition of keyId hurts interoperability**

The current text leaves the format and semantics of keyId completely up to the implementation. This is primarily due to the fact that most implementers of Cavage have extensive investment in key distribution and management, and just need to plug an identifier into the header. We should support those cases, but we also need to provide guidance for the developer that doesn't have that and just wants to know how to identify a key. It may be enough to punt this to profiling specs, but this needs to be explored more.

### **B.1.3. Algorithm Registry duplicates work of JWA**

JSON Web Algorithms (JWA) [RFC7518] already defines an IANA registry for cryptographic algorithms. This wasn't used by Cavage out of concerns about complexity of JOSE, and issues with JWE and JWS being too flexible, leading to insecure combinations of options. Using JWA's definitions does not need to mean we're using JOSE, however. We should look at if/how we can leverage JWA's work without introducing too many sharp edges for implementers.

In any use of JWS algorithms, this spec would define a way to create the JWS Signing Input string to be applied to the algorithm. It should be noted that this is incompatible with JWS itself, which requires the inclusion of a structured header in the signature input.

A possible approach is to incorporate all elements of the JWA signature algorithm registry into this spec using a prefix or other marker, such as jws-RS256 for the RSA 256 JSON Web Signature algorithm.

#### **B.1.4. Algorithm Registry should not be initialized with deprecated entries**

The initial entries in this document reflect those in Cavage. The ones that are marked deprecated were done so because of the issue explained in [Appendix B.1.1](#), with the possible exception of rsa-sha1. We should probably just remove that one.

#### **B.1.5. No percent-encoding normalization of path/query**

See: [issue #26](#)

The canonicalization rules for (request-target) do not perform handle minor, semantically meaningless differences in percent-encoding, such that verification could fail if an intermediary normalizes the effective request URI prior to forwarding the message.

At a minimum, they should be case and percent-encoding normalized as described in sections [6.2.2.1](#) and [6.2.2.2](#) of [\[RFC3986\]](#).

#### **B.1.6. Misleading name for headers parameter**

The Covered Content list contains identifiers for more than just headers, so the header parameter name is no longer appropriate. Some alternatives: "content", "signed-content", "covered-content".

#### **B.1.7. Changes to whitespace in header field values break verification**

Some header field values contain RWS, OWS, and/or BWS. Since the header field value canonicalization rules do not address whitespace, changes to it (e.g., removing OWS or BWS or replacing strings of RWS with a single space) can cause verification to fail.

#### **B.1.8. Multiple Set-Cookie headers are not well supported**

The Set-Cookie header can occur multiple times but does not adhere to the list syntax, and thus is not well supported by the header field value concatenation rules.

#### **B.1.9. Covered Content list is not signed**

The Covered Content list should be part of the Signature Input, to protect against malicious changes.

#### **B.1.10. Algorithm is not signed**

The Algorithm should be part of the Signature Input, to protect against malicious changes.

#### **B.1.11. Verification key identifier is not signed**

The Verification key identifier (e.g., the value used for the keyId parameter) should be part of the Signature Input, to protect against malicious changes.

#### **B.1.12. Max values, precision for Integer String and Decimal String not defined**

The definitions for Integer String and Decimal String do not specify a maximum value. The definition for Decimal String (used to provide sub-second precision for Expiration Time) does not define minimum or maximum precision requirements. It should set a sane requirement here (e.g., MUST support up to 3 decimal places and no more).

#### **B.1.13. keyId parameter value could break list syntax**

The keyId parameter value needs to be constrained so as to not break list syntax (e.g., by containing a comma).

#### **B.1.14. Creation Time and Expiration Time do not allow for clock skew**

The processing instructions for Creation Time and Expiration Time imply that verifiers are not permitted to account for clock skew during signature verification.

#### **B.1.15. Should require lowercased header field names as identifiers**

The current text allows mixed-case header field names when they are being used as content identifiers. This is unnecessary, as header field names are case-insensitive, and creates opportunity for incompatibility. Instead, content identifiers should always be lowercase.

#### **B.1.16. Reconcile Date header and Creation Time**

The draft is missing guidance on if/how the Date header relates to signature Creation Time. There are cases where they may be different, such as if a signature was pre-created. Should Creation Time default to the value in the Date header if the created parameter is not specified?



#### **B.1.17. Remove algorithm-specific rules for content identifiers**

The rules that restrict when the signer can or must include certain identifiers appear to be related to the pseudo-revving of the Cavage draft that happened when the hs2019 algorithm was introduced. We should drop these rules, as it can be expected that anyone implementing this draft will support all content identifiers.

#### **B.1.18. Add guidance for signing compressed headers**

The draft should provide guidance on how to sign headers when [HTTP/2 header compression \[RFC7541\]](#) is used. This guidance might be as simple as "sign the uncompressed header field value."

#### **B.1.19. Transformations to Via header field value break verification**

Intermediaries are permitted to strip comments from the Via header field value, and consolidate related sequences of entries. The canonicalization rules do not account for these changes, and thus they cause signature verification to fail if the Via header is signed. At the very least, guidance on signing or not signing Via headers needs to be included.

#### **B.1.20. Case changes to case-insensitive header field values break verification**

Some header field values are case-insensitive, in whole or in part. The canonicalization rules do not account for this, thus a case change to a covered header field value causes verification to fail.

#### **B.1.21. Need more examples for Signature header**

Add more examples showing different cases e.g, where created or expires are not present.

#### **B.1.22. Expiration not needed**

In many cases, putting the expiration of the signature into the hands of the signer opens up more options for failures than necessary. Instead of the expires, any verifier can use the created field and an internal lifetime or offset to calculate expiration. We should consider dropping the expires field.

## **B.2. Features**

### **B.2.1. Define more content identifiers**

It should be possible to independently include the following content and metadata properties in Covered Content:

- \*The signature's Algorithm
- \*The signature's Covered Content
- \*The value used for the keyId parameter
- \*Request method
- \*Individual components of the effective request URI: scheme, authority, path, query
- \*Status code
- \*Request body (currently supported via Digest header)

### **B.2.2. Multiple signature support**

[[ Editor's note: I believe this use case is theoretical. Please let me know if this is a use case you have. ]]

There may be scenarios where attaching multiple signatures to a single message is useful:

- \*A gateway attaches a signature over headers it adds (e.g., Forwarded) to messages already signed by the user agent.
- \*A signer attaches two signatures signed by different keys, to be verified by different entities.

This could be addressed by changing the Signature header syntax to accept a list of parameter sets for a single signature, e.g., by separating parameters with ";" instead of ",". It may also be necessary to include a signature identifier parameter.

### **B.2.3. Support for incremental signing of header field value list items**

[[ Editor's note: I believe this use case is theoretical. Please let me know if this is a use case you have. ]]

Currently, signing a header field value is all-or-nothing: either the entire value is signed, or none of it is. For header fields that

use list syntax, it would be useful to be able to specify which items in the list are signed.

A simple approach that allowed the signer to indicate the list size at signing time would allow a signer to sign header fields that are may be appended to by intermediaries as the message makes its way to the recipient. Specifying list size in terms of number of items could introduce risks of list syntax is not strictly adhered to (e.g., a malicious party crafts a value that gets parsed by the application as 5 items, but by the verifier as 4). Specifying list size in number of octets might address this, but more exploration is required.

#### **B.2.4. Support expected authority changes**

In some cases, the authority of the effective request URI may be expected to change, for example from "public-service-name.example.com" to "service-host-1.public-service-name.example.com". This is commonly the case for services that are hosted behind a load-balancing gateway, where the client sends requests to a publicly known domain name for the service, and these requests are transformed by the gateway into requests to specific hosts in the service fleet.

One possible way to handle this would be to special-case the Host header field to allow verifier to substitute a known expected value, or a value provided in another header field (e.g., Via) when generating the Signature Input, provided that the verifier also recognizes the real value in the Host header. Alternatively, this logic could apply to an (audience) content identifier.

#### **B.2.5. Support for signing specific cookies**

A signer may only wish to sign one or a few cookies, for example if the website requires its authentication state cookie to be signed, but also sets other cookies (e.g., for analytics, ad tracking, etc.)

### **Acknowledgements**

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## Document History

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

### **\*draft-ietf-httpbis-message-signatures**

**--00**

- oCopied from draft-richanna-http-message-signatures

- oCorrected header field content identifiers in Table 1.

### **\*draft-richanna-http-message-signatures**

**--00**

- oConverted to xml2rfc v3 and reformatted to comply with RFC style guides.

- oRemoved Signature auth-scheme definition and related content.

- oRemoved conflicting normative requirements for use of algorithm parameter. Now **MUST NOT** be relied upon.

- oRemoved Extensions appendix.

- oRewrote abstract and introduction to explain context and need, and challenges inherent in signing HTTP messages.

- oRewrote and heavily expanded algorithm definition, retaining normative requirements.

- oAdded definitions for key terms, referenced RFC 7230 for HTTP terms.

- oAdded examples for canonicalization and signature generation steps.

- oRewrote Signature header definition, retaining normative requirements.

- oAdded default values for algorithm and expires parameters.

- oRewrote HTTP Signature Algorithms registry definition.  
Added change control policy and registry template. Removed suggested URI.
- oAdded IANA HTTP Signature Parameter registry.
- oAdded additional normative and informative references.
- oAdded Topics for Working Group Discussion section, to be removed prior to publication as an RFC.

### **Authors' Addresses**

Annabelle Backman (editor)  
Amazon  
P.O. Box 81226  
Seattle, WA 98108-1226  
United States of America

Email: [richanna@amazon.com](mailto:richanna@amazon.com)  
URI: <https://www.amazon.com/>

Justin Richer  
Bespoke Engineering

Email: [ietf@justin.richer.org](mailto:ietf@justin.richer.org)  
URI: <https://bspk.io/>

Manu Sporny  
Digital Bazaar  
203 Roanoke Street W.  
Blacksburg, VA 24060  
United States of America

Phone: [+1 540 961 4469](tel:+15409614469)  
Email: [msporny@digitalbazaar.com](mailto:msporny@digitalbazaar.com)  
URI: <https://manu.sporny.org/>