YAML Media Type

Abstract

This document registers the application/yaml media type and the +yaml structured syntax suffix on the IANA Media Types registry, intended to be used to identify document components serialized according to the YAML specification.

About This Document

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

Status information for this document may be found at https://datatracker.ietf.org/doc/draft-ietf-httpapi-yaml-mediatypes/.

Discussion of this document takes place on the HTTPAPI Working Group mailing list (mailto:httpapi@ietf.org), which is archived at https://mailarchive.ietf.org/arch/browse/httpapi/. Subscribe at https://www.ietf.org/mailman/listinfo/httpapi/. Working Group information can be found at https://datatracker.ietf.org/wg/httpapi/about/.

Source for this draft and an issue tracker can be found at https://github.com/ietf-wg-httpapi/mediatypes/labels/yaml.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

YAML [YAML] is a data serialization format that is capable of conveying one or multiple documents in a single presentation stream (e.g., a file or a network resource). It is widely used on the Internet, including in the API sector (e.g., see [OAS]), but a corresponding media type and structured syntax suffix had not previously been registered by IANA.

To increase interoperability when exchanging YAML streams, and leverage content negotiation mechanisms when exchanging YAML resources, this specification registers the application/yaml media type and the +yaml structured syntax suffix [MEDIATYPE].

Moreover, it provides security considerations and interoperability considerations related to [YAML], including its relation with [JSON].

1.1. Notational Conventions

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. These words may also appear in this document in lower case as plain English words, absent their normative meanings.

The terms "content", "content negotiation", "resource", and "user agent" in this document are to be interpreted as in [HTTP].

The terms "fragment" and "fragment identifier" in this document are to be interpreted as in [URI].

The terms "presentation", "stream", "YAML document", "representation graph", "tag", "serialization detail", "node", "alias node", "anchor" and "anchor name" in this document are to be interpreted as in [YAML].

Figures containing YAML code always start with the "%YAML 1.2" directive to improve readability.
1.2. Fragment identification

A fragment identifies a node in a stream.

A fragment identifier starting with "*" is to be interpreted as a YAML alias node (see Section 1.2.1).

For single-document YAML streams, a fragment identifier that is empty or that starts with "/" is to be interpreted as a JSON Pointer [JSON-POINTER] and is evaluated on the YAML representation graph, walking through alias nodes; in particular, the empty fragment identifier references the root node. This syntax can only reference the YAML nodes that are on a path that is made up of nodes interoperable with the JSON data model (see Section 3.4).

A fragment identifier is not guaranteed to reference an existing node. Therefore, applications SHOULD define how an unresolved alias node ought to be handled.

1.2.1. Fragment identification via alias nodes

This section describes how to use alias nodes (see Section 3.2.2.2 and 7.1 of [YAML]) as fragment identifiers to designate nodes.

A YAML alias node can be represented in a URI fragment identifier by encoding it into bytes using UTF-8 [UTF-8], but percent-encoding of those characters is not allowed by the fragment rule in Section 3.5 of [URI].

If multiple nodes would match a fragment identifier, the first occurrence of such match is selected.

Users concerned with interoperability of fragment identifiers:

*SHOULD limit alias nodes to a set of characters that do not require encoding to be expressed as URI fragment identifiers: this is generally possible since anchor names are a serialization detail;

*SHOULD NOT use alias nodes that match multiple nodes.

In the example resource below, the relative reference (see Section 4.2 of [URI]) file.yaml#*foo identifies the first alias node *foo pointing to the node with value scalar and not the one in the second document; whereas the relative reference file.yaml#*document_2 identifies the root node of the second document {one: [a, sequence]}. 
%YAML 1.2
---
one: &foo scalar
two: &bar
  - some
  - sequence
  - items
...
%YAML 1.2
---
&document_2
one: &foo [a, sequence]

Figure 1: A YAMl stream containing two YAMl documents.

2. Media Type and Structured Syntax Suffix registrations

This section describes the information required to register the above media type according to [MEDIATYPE]

2.1. Media Type application/yaml

The media type for YAMl text is application/yaml; the following information serves as the registration form for this media type.

Type name: application

Subtype name: yam1

Required parameters: N/A

Optional parameters: N/A; unrecognized parameters should be ignored

Encoding considerations: binary

Security considerations: see Section 4 of this document

Interoperability considerations: see Section 3 of this document

Published specification: [YAMl], this document

Applications that use this media type: Applications that need a human-friendly, cross language, Unicode based data serialization language designed around the common native data types of dynamic programming languages.

Fragment identifier considerations: See Section 1.2 of this document
2.2. The +yaml Structured Syntax Suffix

The suffix +yaml MAY be used with any media type whose representation follows that established for application/yaml. The media type structured syntax suffix registration form follows. See [MEDIATYPE] for definitions of each of the registration form headings.

**Name:** YAML Ain't Markup Language (YAML)

**+suffix:** +yaml

**References:** [YAML], this document

**Encoding considerations:** Same as "application/yaml"

**Fragment identifier considerations:** Differently from application/yaml, there is no fragment identification syntax defined for +yaml.

A specific xxx/yyy+yaml media type needs to define the syntax and semantics for fragment identifiers because the ones defined for "application/yaml" do not apply unless explicitly expressed.

**Interoperability considerations:** Same as "application/yaml"
Security considerations: Same as "application/yaml"

Contact: httpapi@ietf.org or art@ietf.org

Author: See the Authors' Addresses section of this document

Change controller: IETF

3. Interoperability Considerations

3.1. YAML is an Evolving Language

YAML is an evolving language and, over time, some features have been added and others removed.

This [YAML] media type registration is independent of YAML version. This allows content negotiation of version-independent YAML resources.

Implementers concerned about features related to a specific YAML version can specify it in YAML documents using the %YAML directive (see Section 6.8.1 of [YAML]).

3.2. YAML streams

A YAML stream can contain zero or more YAML documents.

When receiving a multi-document stream, an application that only expects one-document streams, ought to signal an error instead of ignoring the extra documents.

Current implementations consider different documents in a stream independent, similarly to JSON Text Sequences (see [RFC7464]); elements such as anchors are not guaranteed to be referenceable across different documents.

3.3. Filename extension

The "yaml" filename extension is the preferred one; it is the most popular and widely used on the web. The "yml" filename extension is still used. The simultaneous usage of two filename extensions in the same context might cause interoperability issues (e.g., when both a "config.yaml" and a "config.yml" are present).

3.4. YAML and JSON

When using flow collection styles (see Section 7.4 of [YAML]) a YAML document could look like JSON [JSON], thus similar interoperability considerations apply.
When using YAML as a more efficient format to serialize information intended to be consumed as JSON, information not reflected in the representation graph and classified as presentation or serialization detail (see Section 3.2 of [YAML]) can be discarded. This includes comments (see Section 3.2.3.3 of [YAML]), directives, and alias nodes (see Section 7.1 of [YAML]) that do not have a JSON counterpart.

%YAML 1.2
---
# This comment will be lost
# when serializing in JSON.
Title:
  type: string
  maxLength: &text_limit 64
Name:
  type: string
  maxLength: *text_limit  # Replaced by the value 64.

Figure 2: JSON replaces alias nodes with static values.

Implementers need to ensure that relevant information will not be lost during the processing. For example, they might consider acceptable that alias nodes are replaced by static values.

In some cases an implementer may want to define a list of allowed YAML features, taking into account that the following ones might have interoperability issues with [JSON]:

* multi-document YAML streams;

* non UTF-8 encoding. Before encoding YAML streams in UTF-16 or UTF-32, it is important to note that Section 8.1 of [JSON] mandates the use of UTF-8 when exchanging JSON texts between systems that are not part of a closed ecosystem, and that Section 5.2 of [YAML] recommends the use of UTF-8;

* mapping keys that are not strings;

* circular references represented using anchor (see Section 4.2 and Figure 4);

* .inf and .nan float values, since JSON does not support them;

* non-JSON types, including the ones associated with tags like !!timestamp that were included in the default schema of older YAML versions;
*tags in general, and specifically the ones that do not map to JSON types like custom and local tags such as `!!python/object` and `!mytag` (see Section 2.4 of [YAML]);

```yaml
%YAML 1.2
---
non-json-keys:
  0: a number
  [0, 1]: a sequence
  ? {k: v}
  : a map
---
non-json-keys:
  !date 2020-01-01: a timestamp
non-json-value: !date 2020-01-01
...
```

Figure 3: Example of mapping keys and values not supported in JSON in a multi-document YAML stream

3.5. Fragment identifiers

To allow fragment identifiers to traverse alias nodes, the YAML representation graph needs to be generated before the fragment identifier evaluation. It is important that this evaluation will not cause the issues mentioned in Section 3.4 and in Security considerations (Section 4) such as infinite loops and unexpected code execution.

Implementers need to consider that the YAML version and supported features (e.g., merge keys) can affect the generation of the representation graph (see Figure 9).

In Section 2.1, this document extends the use of specifications based on the JSON data model with support for YAML fragment identifiers. This is to improve the interoperability of already consolidated practices, such as the one of writing OpenAPI documents [OAS] in YAML.

Appendix A provides a non-exhaustive list of examples that could help understand interoperability issues related to fragment identifiers.

4. Security Considerations

Security requirements for both media type and media type suffix registrations are discussed in Section 4.6 of [MEDIATYPE].
4.1. Arbitrary Code Execution

Care should be used when using YAML tags, because their resolution might trigger unexpected code execution.

Code execution in deserializers should be disabled by default, and only be enabled explicitly. In those cases, the implementation should ensure - for example, via specific functions - that the code execution results in strictly bounded time/memory limits.

Many implementations provide safe deserializers addressing these issues.

4.2. Resource Exhaustion

YAML documents are rooted, connected, directed graphs and can contain reference cycles, so they can't be treated as simple trees (see Section 3.2.1 of [YAML]). An implementation that treats them as simple trees risks going into an infinite loop while traversing the YAML representation graph. This can happen:

* when trying to serialize it as JSON;

* or when searching/identifying nodes using specifications based on the JSON data model (e.g., [JSON-POINTER]).

```yaml
%YAML 1.2
---
x: &x
  y: *x
```

Figure 4: A cyclic document

Even if a representation graph is not cyclic, treating it as a simple tree could lead to improper behaviors (such as the "billion laughs" or "Exponential Entity Expansion" problem).

```yaml
%YAML 1.2
---

x1: &a1 ["a", "a"]
x2: &a2 [*a1, *a1]
x3: &a3 [*a2, *a2]
```

Figure 5: A billion laughs document

This can be addressed using processors limiting the anchor recursion depth and validating the input before processing it; even in these cases it is important to carefully test the implementation you are
going to use. The same considerations apply when serializing a YAML representation graph in a format that does not support reference cycles (see Section 3.4).

4.3. YAML streams

Incremental parsing and processing of a YAML stream can produce partial results and later indicate failure to parse the remainder of the stream; to prevent partial processing, implementers might prefer validating and processing all the documents in a stream at the same time.

Repeated parsing and re-encoding of a YAML stream can result in the addition or removal of document delimiters (e.g., --- or ...) as well as the modification of anchor names and other serialization details, which can break signature validation.

4.4. Expressing booleans

Section 10.3.2 of [YAML] specifies that only the scalars matching the regular expression true|True|TRUE|false|False|FALSE are interpreted as booleans. Older YAML versions were more tolerant (e.g., interpreting NO and N as False, and YES and Y as True). When the older syntax is used, a YAML implementation could then interpret {insecure: n} as {insecure: "n"} instead of {insecure: false}. Using the syntax defined in Section 10.3.2 of [YAML] prevents these issues.

5. IANA Considerations

This specification defines the following new Internet media type [MEDIATYPE].

IANA is asked to update the "Media Types" registry at https://www.iana.org/assignments/media-types with the registration information provided in the section below.

<table>
<thead>
<tr>
<th>Media Type</th>
<th>Registration information section</th>
</tr>
</thead>
<tbody>
<tr>
<td>application/yaml</td>
<td>Section 2.1 of this document</td>
</tr>
</tbody>
</table>

Table 1

IANA is asked to update the "Structured Syntax Suffixes" registry at https://www.iana.org/assignments/media-type-structured-suffix with the registration information provided in the section below.

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Registration information section</th>
</tr>
</thead>
<tbody>
<tr>
<td>+yaml</td>
<td>Section 2.2 of this document</td>
</tr>
</tbody>
</table>

Table 2
6. References

6.1. Normative References


6.2. Informative References


Appendix A. Examples related to fragment identifier interoperability

A.1. Unreferenceable nodes

In this example, a couple of YAML nodes that cannot be referenced based on the JSON data model since their mapping keys are not strings.

```
---
a-map-cannot:
  ? {be: expressed}
  : with a JSON Pointer

0: no numeric mapping keys in JSON

Figure 6: Example of YAML nodes that are not referenceable based on JSON data model.
```

A.2. Referencing a missing node

In this example the fragment `#/0` does not reference an existing node.

```
---
0: "JSON Pointer `#/0` references a string mapping key."

Figure 7: Example of a JSON Pointer that does not reference an existing node.
```

A.3. Representation graph with anchors and cyclic references

In this YAML document, the `/foo/bar/baz` fragment identifier traverses the representation graph and references the string `you`. Moreover, the presence of a cyclic reference implies that there are
infinite fragment identifiers #/foo/bat/../bat/bar referencing the &anchor node.

%YAML 1.2
---
anchor: &anchor
  baz: you
foo: &foo
  bar: *anchor
  bat: *foo

Figure 8: Example of a cyclic reference and alias nodes.

Many YAML implementations will resolve the merge key "<<:" defined in YAML 1.1 in the representation graph. This means that the fragment #/book/author/given_name references the string Federico and that the fragment #/book/<< will not reference any existing node.

%YAML 1.1
---
# Many implementations use merge keys.
the-viceroys: &the-viceroys
  title: The Viceroy
  author:
    given_name: Federico
    family_name: De Roberto
  book:
    <<: *the-viceroys
    title: The Illusion

Figure 9: Example of YAML merge keys.

Acknowledgements

Thanks to Erik Wilde and David Biesack for being the initial contributors of this specification, and to Darrel Miller and Rich Salz for their support during the adoption phase.

In addition to the people above, this document owes a lot to the extensive discussion inside and outside the HTTPAPI workgroup. The following contributors have helped improve this specification by opening pull requests, reporting bugs, asking smart questions, drafting or reviewing text, and evaluating open issues:

  Tina (tinita) Müller, Ben Hutton, Carsten Bormann, Manu Sporny and Jason Desrosiers.
FAQ

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

Q: Why this document?  After all these years, we still lack a proper media-type for YAML. This has some security implications too (eg. wrt identifying parsers or treat downloads)

Q: Why using alias nodes as fragment identifiers?  Alias nodes are a native YAML feature that allows addressing any node in a YAML document. Since YAML is not limited to string keywords, not all nodes are addressable using JSON Pointers. Alias nodes are thus the natural choice for fragment identifiers [Section 1.2].

Q: Why not use plain names for alias nodes? Why not define plain names?
Using plain name fragments could have limited the ability of future xxx+yaml media types to define their plain name fragments. Moreover, alias nodes starts with * so we found no reason to strip it when using them in fragments.

Preserving * had another positive result: it allows distinguishing a fragment identifier expressed as an alias node from one expressed in other formats. In this document we included JSON Pointer [JSON-POINTER] which is expected to start with /. Moreover, since JSON Path [I-D.ietf-jsonpath-base] expressions start with $, this mechanism can be extended to JSON Path too.

Q: Why not just use JSON Pointer as the primary fragment identifier?
Fragment identifiers in YAML always reference YAML representation graph nodes. JSON Pointer can only rely on string keywords so it is not able to reference a generic node in the representation graph.

Since JSON Pointer is a specification unrelated to YAML, we decided to isolate the impacts of changes in JSON Pointer on YAML fragments: only fragments starting with "/" are "delegated" to an external spec, and if [JSON-POINTER] changes, it will only affect fragments starting with "/".

The current behaviour for empty fragments is the same for both JSON Pointer and alias nodes. Incidentally, it's the only sensible behaviour independently of [JSON-POINTER].

Q: Why describe the YAML/JSON so closely?  In the context of Web APIs, YAML is widely used as a more compact way to serialize content intended to be consumed according to the JSON data model. Typical examples are OpenAPI specifications and Kubernetes manifest files, that can be serialized in both formats. The YAML media type registration I-D is a spin-off and a building block
for the OpenAPI specification media type registration. The YAML/JSON section aims at clarifying what developers should expect when using YAML instead of JSON, and its content arose from common mistakes and FAQs.

Please note that we are not imposing any normative restriction on YAML streams; this is because YAML is defined outside this document. Instead, we only provide Interoperability and Security considerations that, by their nature, are not normative.

Q: **Do we forbid using non-UTF-8 YAML serialization?** No. Since [JSON] recommends UTF-8 in interoperability context we suggest that using UTF-8 is an interoperable behavior. This is aligned with Section 5.2 of [YAML] that explicitly recommends UTF-8.

Q: **Why media type registration information is outside the IANA Considerations?** We decided to follow the style adopted in [HTTP] where the IANA Considerations in Section 18.8 of [HTTP] references the multipart/byteranges media type registration form contained in the specification body Section 14.6 of [HTTP].

**Change Log**

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

Since draft-ietf-httpapi-yaml-mediatypes-02

*clarification on fragment identifiers #50.

Since draft-ietf-httpapi-yaml-mediatypes-01

*application/yaml fragment identifiers compatible with JSON Pointer #41 (#47).

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