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Author: K. Smith
Vodafone

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api-catalog: A Well-Known URI and Link Relation to Help Discovery of APIs

Abstract

This document defines the "api-catalog" well-know URI and link relation. It is intended to facilitate automated discovery and usage of published Application Programming Interfaces (APIs). A request to the api-catalog resource will return a document providing information about, and links to, the Publisher's APIs.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <https://www.rfc-editor.org/info/rfc9727>.

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1. Introduction

An application may publish APIs to encourage requests for interaction from external parties. Such APIs must be discovered before they may be used, i.e., the external party needs to know what APIs a given Publisher exposes, their purpose, any policies for usage, and the endpoint to interact with each API. To facilitate automated discovery of this information and automated usage of the APIs, this document proposes:

- a well-known URI [[WELL-KNOWN](#)], 'api-catalog', that is encoded as a URI reference to an API catalog document describing a Publisher's API endpoints.
- a link relation [[WEB-LINKING](#)], 'api-catalog', of which the target resource is the Publisher's API catalog document.

1.1. Goals and Non-Goals

The primary goal is to facilitate the automated discovery of a Publisher's public API endpoints, along with metadata that describes the purpose and usage of each API, by specifying a well-known URI that returns an API catalog document. The API catalog document is primarily machine-readable to enable automated discovery and usage of APIs, and it may also include links to human-readable documentation (see the example in [Appendix A.1](#)).

Non-goals: This document does not mandate paths for API endpoints, i.e., it does not mandate that `my_example_api`'s endpoint should be `https://www.example.com/.well-known/api-catalog/my_example_api`, nor even to be hosted at `www.example.com` (although it is not forbidden to do so).

1.2. 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 negotiation" and "status code" are from [HTTP]. The term "well-known URI" is from [WELL-KNOWN]. The term "link relation" is from [WEB-LINKING].

The term "Publisher" refers to an organisation, company, or individual that publishes one or more APIs for use by external third parties. A fictional Publisher named "example" is used throughout this document. The examples use the Fully Qualified Domain Names (FQDNs) "www.example.com", "developer.example.com", "apis.example.com", "apis.example.net", "gaming.example.com", and "iot.example.net", where the .com and .net Top-Level Domains (TLDs) and various subdomains are simply used to illustrate that the "example" Publisher may have their API portfolio distributed across various domains for which they are the authority. Scenarios where the Publisher "example" is not the authority for a given *example.* domain are made explicit in the text.

In this document, "API" refers to the specification resources required for an external party (or in the case of 'private' APIs, an internal party) to implement software that uses the Publisher's API.

The specification recommends the use of TLS. Hence, "HTTPS" and "https://" are used throughout.

2. Using the 'api-catalog' Well-Known URI

The api-catalog well-known URI is intended for HTTPS servers that publish APIs.

- The API catalog **MUST** be named "api-catalog" in a well-known location as described by [WELL-KNOWN].
- The location of the API catalog document is decided by the Publisher. The /.well-known/api-catalog URI provides a convenient reference to that location.

A Publisher supporting this URI:

- **SHALL** resolve an HTTPS GET request to /.well-known/api-catalog and return an API catalog document (as described in Section 4).
- **SHALL** resolve an HTTPS HEAD request to /.well-known/api-catalog with a response including a Link header with the relation(s) defined in Section 3.

3. The api-catalog Link Relation

This document introduces a new link relation [WEB-LINKING], "api-catalog". This identifies a target resource that represents a list of APIs available from the Publisher of the link context. The target resource URI may be `/.well-known/api-catalog` or any other URI chosen by the Publisher. For example, the Publisher 'example' could include the api-catalog link relation in the HTTP header and/or content payload when responding to a request to `https://www.example.com`:

```
HTTP/1.1 200 OK
Content-Type: text/html; charset=UTF-8
Location: /index.html
Link: </my_api_catalog.json>; rel=api-catalog
Content-Length: 356

<!DOCTYPE HTML>
<html>
  <head>
    <title>Welcome to Example Publisher</title>
  </head>
  <body>
    <p>
      <a href="/my_api_catalog.json" rel="api-catalog">
        Example Publisher's APIs
      </a>
    </p>
    <p>(remainder of content)</p>
  </body>
</html>
```

3.1. Using Additional Link Relations

- "item" [RFC6573]. When used in an API catalog document, the "item" link relation identifies a target resource that represents an API that is a member of the API catalog.
- Other link relations may be utilised in an API catalog to convey metadata descriptions for API links.

4. The API Catalog Document

The API catalog is a document listing a Publisher's APIs. The Publisher may host the API catalog document at any URI(s) they choose. As illustration, the API catalog document URI of `https://www.example.com/my_api_catalog.json` can be requested directly or via a request to `https://www.example.com/.well-known/api-catalog`, which the Publisher will resolve to `https://www.example.com/my_api_catalog`.

4.1. API Catalog Contents

The API catalog **MUST** include hyperlinks to API endpoints, and is **RECOMMENDED** to include useful metadata, such as usage policies, API version information, links to the OpenAPI Specification [OAS] definitions for each API, etc. If the Publisher does not include that metadata directly in the API catalog document, they **SHOULD** make that metadata available at the API endpoint URIs they have listed (see [Appendix A.2](#) for an example).

4.2. API Catalog Formats

The Publisher **MUST** publish the API catalog document in the Linkset format application/linkset+json (Section 4.2 of [RFC9264]). The Linkset **SHOULD** include a profile parameter (Section 5 of [RFC9264]) with a Profile URI [RFC7284] value of 'https://www.rfc-editor.org/info/rfc9727' to indicate the Linkset is representing an API catalog document as defined above. [Appendix A](#) includes example API catalog documents based on the Linkset format.

The Publisher **MAY** make additional formats available via content negotiation (Section 12 of [HTTP]) to their /.well-known/api-catalog location. A non-exhaustive list of such formats that support the automated discovery and machine (and human) usage of a Publisher's APIs is listed at [Appendix A.3](#). If a Publisher already lists their APIs in a format other than Linkset, but wishes to utilise the /.well-known/api-catalog URI, then:

- They **MUST** also implement a Linkset with, at minimum, hyperlinks to API endpoints; see [Appendix A.2](#).
- They **MAY** support content negotiation at the /.well-known/api-catalog URI to allow for the return of their existing format.

4.3. Nesting API Catalog Links

An API catalog may itself contain links to other API catalogs by using the 'api-catalog' relation type for each link. An example of this is given in [Appendix A.4](#).

5. Operational Considerations

5.1. Accounting for APIs Distributed Across Multiple Domains

A Publisher ("example") may have their APIs hosted across multiple domains that they manage, e.g., at `www.example.com`, `developer.example.com`, `apis.example.com`, `apis.example.net`, etc. They may also use a third-party API hosting provider that hosts APIs on a distinct domain.

To account for this scenario, it is **RECOMMENDED** that:

- The Publisher also publish the api-catalog well-known URI at each of their API domains, e.g., `https://apis.example.com/.well-known/api-catalog`, `https://developer.example.net/.well-known/api-catalog`, etc.

- An HTTPS GET request to any of these URIs returns the same result, namely, the API catalog document.
- The Publisher choose one of their instances of `/.well-known/api-catalog` as a canonical reference to the location of the latest API catalog since the physical location of the API catalog document is decided by the Publisher and may change. The Publisher's other instances of `/.well-known/api-catalog` should redirect to this canonical instance of `/.well-known/api-catalog` to ensure the latest API catalog is returned.

For example, if the Publisher's primary API portal is `https://apis.example.com`, then `https://apis.example.com/.well-known/api-catalog` should resolve to the location of the Publisher's latest API catalog document. If the Publisher is also the domain authority for `www.example.net`, which also hosts a selection of their APIs, then a request to `https://www.example.net/.well-known/api-catalog` should redirect to `https://apis.example.com/.well-known/api-catalog`.

If the Publisher is not the domain authority for `www.example.net` -- or any third-party domain that hosts any of the Publisher's APIs -- then the Publisher **MAY** include a link in its own API catalog to that third-party domain's API catalog. For example, the API catalog available at `https://apis.example.com/.well-known/api-catalog` may list APIs hosted at `apis.example.com` and also link to the API catalog hosted at `https://www.example.net/.well-known/api-catalog` using the "api-catalog" link relation:

```
{
  "linkset": [
    {
      "anchor": "https://www.example.com/.well-known/api-catalog",
      "item": [
        {
          "href": "https://developer.example.com/apis/foo_api"
        },
        {
          "href": "https://developer.example.com/apis/bar_api"
        },
        {
          "href": "https://developer.example.com/apis/cantona_api"
        }
      ],
      "api-catalog": "https://www.example.net/.well-known/api-catalog"
    }
  ]
}
```

5.2. Internal Use of api-catalog for Private APIs

A Publisher may wish to use the api-catalog well-known URI on their internal network to signpost authorised users (e.g., company employees) towards internal/private APIs not intended for third-party use. This scenario may incur additional security considerations as noted in [Section 8](#).

5.3. Scalability Guidelines

In cases where a Publisher has a large number of APIs potentially deployed across multiple domains, two challenges may arise:

- Maintaining the catalog entries to ensure they are up to date and correcting any errors.
- Restricting the catalog size to help reduce network and client-processing overheads.

In both cases, a Publisher may benefit from grouping their APIs, providing an API catalog document for each group and using the main API catalog hosted at `/.well-known/api-catalog` to provide links to these. For example, a Publisher may decide to group their APIs according to a business category (e.g., 'gaming APIs', 'anti-fraud APIs', etc.), a technology category (e.g., 'IOT', 'networks', 'AI', etc.), or any other criterion. This grouping may already be implicit where the Publisher has already published their APIs across multiple domains, e.g., at `gaming.example.com`, `iot.example.net`, etc.

[Section 4.3](#) shows how the API catalog at `/.well-known/api-catalog` can use the `api-catalog` link relation to point to other API catalogs.

The Publisher **SHOULD** consider caching and compression techniques to reduce the network overhead of large API catalogs.

5.4. Monitoring and Maintenance

Publishers are **RECOMMENDED** to follow operational best practice when hosting API catalog(s), including, but not limited to:

- Availability. The Publisher should monitor availability of the API catalog and consider alternate means to resolve requests to `/.well-known/api-catalog` during planned downtime of hosts.
- Performance. Although the performance of APIs listed in an API catalog can demand high transactions per second and low-latency response, the retrieval of the API catalog itself to discover those APIs is less likely to incur strict performance demands. That said, the Publisher should monitor the response time to fulfil a request for the API catalog and determine any necessary improvements (as with any other Web resource the Publisher serves). For large API catalogs, the Publisher should consider the techniques described in [Section 5.3](#).
- Usage. Since the goal of the `api-catalog` well-known URI is to facilitate discovery of APIs, the Publisher may wish to correlate requests to the `/.well-known/api-catalog` URI with subsequent requests to the API URIs listed in the catalog.
- Current data. The Publisher should include the removal of stale API entries from the API catalog as part of their API release lifecycle. The Publisher **MAY** decide to include metadata regarding legacy API versions or deprecated APIs to help users of those APIs discover up-to-date alternatives.

- Correct metadata. The Publisher should include human and/or automated checks for syntax errors in the API catalog. Automated checks include format validation (e.g., to ensure valid JSON syntax) and linting to enforce business rules, such as removing duplicate entries and ensuring descriptions are correctly named with valid values. A proofread of the API catalog as part of the API release lifecycle is **RECOMMENDED** to detect any errors in business grammar (for example, an API entry that is described with valid syntax, but has been allocated an incorrect or outdated description.)
- Security best practice. See [Section 8](#).

5.5. Integration with Existing API Management Frameworks

A Publisher may already utilise an API management framework to produce their API portfolio. These frameworks typically include the publication of API endpoint URIs, deprecation and redirection of legacy API versions, API usage policies and documentation, etc. The api-catalog well-known URI and API catalog document are intended to complement API management frameworks by facilitating the discovery of the framework's outputs -- API endpoints, usage policies, and documentation -- and are not intended to replace any existing API discovery mechanisms the framework has implemented.

Providers of such frameworks may include the production of an API catalog and the publication of the /.well-known/api-catalog URI as a final pre-release (or post-release) step in the release management workflow. The following steps are recommended.

If the /.well-known/api-catalog URI has not been published previously, the framework provider should:

- Collate and check the metadata for each API that will be included in the API catalog. This metadata is likely to already exist in the framework.
- Determine which metadata to include in the API catalog following the requirements set out in [Section 4.1](#) and the considerations set out in [Section 5](#).
- Map the chosen metadata to the format(s) described in [Section 4.2](#). The structure suggested in [Appendix A.2](#) may be followed where only the hyperlinks to APIs are to be included in the API catalog. Where possible, the API catalog should include further metadata per the guidance in [Section 4.1](#); in which case, the structure suggested in [Appendix A](#) can be utilised and adapted (ensuring compliance to [\[RFC9264\]](#)) to reflect the nature of the chosen metadata.
- Publish the /.well-known/api-catalog URI following the guidance set out in [Section 2](#).

If the /.well-known/api-catalog URI has previously been published, the framework provider should:

- Include a step in the release management lifecycle to refresh the API catalog following any changes in API hyperlinks or published metadata. This could include placing triggers on certain metadata fields, so that as they are updated in pre-production on the API framework, the updates are pushed to a pre-production copy of the API catalog to be pushed live when the release is published by the framework.

6. Conformance to RFC 8615

The requirements in [Section 3](#) of [\[WELL-KNOWN\]](#) for defining Well-Known URIs are met as described in the following subsections.

6.1. Path Suffix

The api-catalog URI **SHALL** be appended to the /.well-known/ path-prefix for "well-known locations".

6.2. Formats and Associated Media Types

A /.well-known/api-catalog location **MUST** support the Linkset [\[RFC9264\]](#) format of application/linkset+json and **MAY** also support the other formats via content negotiation.

6.3. Registration of the api-catalog Well-Known URI

See [Section 7](#) considerations below.

7. IANA Considerations

7.1. The api-catalog Well-Known URI

This specification registers the "api-catalog" well-known URI in the "Well-Known URIs" registry as defined by [\[WELL-KNOWN\]](#).

URI Suffix: api-catalog
Reference: RFC 9727
Status: permanent
Change Controller: IETF

7.2. The api-catalog Link Relation

This specification registers the "api-catalog" link relation in the "Link Relation Types" registry by following the procedures per [Section 2.1.1.1](#) of [\[WEB-LINKING\]](#).

Relation Name: api-catalog
Description: Refers to a list of APIs available from the Publisher of the link context.
Reference: RFC 9727

7.3. The api-catalog Profile URI

This specification registers "https://www.rfc-editor.org/info/rfc9727" in the "Profile URIs" registry according to [\[RFC7284\]](#).

Profile URI: <https://www.rfc-editor.org/info/rfc9727>

Common Name: API catalog

Description: A Profile URI to request or signal a Linkset representing an API catalog.

Reference: RFC 9727

8. Security Considerations

For all scenarios:

- TLS **SHOULD** be used, i.e., make `/.well-known/api-catalog` available exclusively over HTTPS, to ensure no tampering of the API catalog.
- The Publisher **SHOULD** take into account the security considerations from [Section 4](#) of [\[WELL-KNOWN\]](#).
- The Publisher **SHOULD** perform a security and privacy review of the API catalog prior to deployment to ensure it does not leak personal, business, or other sensitive metadata, nor expose any vulnerability related to the APIs listed.
- The Publisher **SHOULD** enforce read-only privileges for external requests to `.well-known/api-catalog` and for internal systems and roles that monitor the `.well-known/api-catalog` URI. Write privileges **SHOULD** only be granted to roles that perform updates to the API catalog and/or the forwarding rewrite rules for the `.well-known/api-catalog` URI.
- As with any Web offering, it is **RECOMMENDED** to apply rate-limiting measures to help mitigate abuse and prevent denial-of-service attacks on the API catalog endpoint.

For the public-facing APIs scenario, security teams **SHOULD** additionally audit the API catalog to ensure no APIs intended solely for internal use have been mistakenly included. For example, a catalog hosted on `https://developer.example.com` should not expose unnecessary metadata about any internal domains (e.g., `https://internal.example.com`).

For the internal/private APIs scenario, the Publisher **SHOULD** take steps to ensure that appropriate controls, such as Cross-Origin Resource Sharing (CORS) policies and access control lists, are in place to ensure only authorised roles and systems may access an internal `api-catalog` well-known URI.

A comprehensive API catalog that is regularly audited may assist the Publisher in decommissioning 'zombie' APIs, i.e., legacy/obsolete APIs that should no longer be available. Such APIs represent a security vulnerability as they are unlikely to be supported, monitored, patched, or updated.

Note the registration of domain names and associated policies is out of scope of this document.

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Appendix A. Example API Catalog Documents

This section is informative and provides an example of an API catalog document using the Linkset format.

A.1. Using Linkset with RFC 8631 Relations

This example uses the Linkset format [RFC9264] and the following link relations defined in [RFC8631]:

"service-desc": Used to link to a description of the API that is primarily intended for machine consumption (for example, the [OAS] specification, YAML, or JSON file).

"service-doc": Used to link to API documentation that is primarily intended for human consumption (an example of human-readable documentation is the IETF [Internet-Draft submission API instructions](#)).

"service-meta": Used to link to additional metadata about the API and is primarily intended for machine consumption.

"status": Used to link to the API status (e.g., API "health" indication) for machine and/or human consumption.

Client request:

```
GET .well-known/api-catalog HTTP/1.1
Host: example.com
Accept: application/linkset+json
```

Server response:

```
HTTP/1.1 200 OK
Date: Mon, 01 Jun 2023 00:00:01 GMT
Server: Apache-Coyote/1.1
Content-Type: application/linkset+json;
  profile="https://www.rfc-editor.org/info/rfc9727"
```

```
{
  "linkset": [
    {
      "anchor": "https://developer.example.com/apis/foo_api",
      "service-desc": [
        {
          "href": "https://developer.example.com/apis/foo_api/spec",
          "type": "application/yaml"
        }
      ]
    }
  ],
}
```

```
{
  "status": [
    {
      "href": "https://developer.example.com/apis/foo_api/status",
      "type": "application/json"
    }
  ],
  "service-doc": [
    {
      "href": "https://developer.example.com/apis/foo_api/doc",
      "type": "text/html"
    }
  ],
  "service-meta": [
    {
      "href": "https://developer.example.com/apis/foo_api/policies",
      "type": "text/xml"
    }
  ]
},
{
  "anchor": "https://developer.example.com/apis/bar_api",
  "service-desc": [
    {
      "href": "https://developer.example.com/apis/bar_api/spec",
      "type": "application/yaml"
    }
  ],
  "status": [
    {
      "href": "https://developer.example.com/apis/bar_api/status",
      "type": "application/json"
    }
  ],
  "service-doc": [
    {
      "href": "https://developer.example.com/apis/bar_api/doc",
      "type": "text/plain"
    }
  ]
},
{
  "anchor": "https://apis.example.net/apis/cantona_api",
  "service-desc": [
    {
      "href": "https://apis.example.net/apis/cantona_api/spec",
      "type": "text/n3"
    }
  ],
  "service-doc": [
    {
      "href": "https://apis.example.net/apis/cantona_api/doc",
      "type": "text/html"
    }
  ]
}
]
```

A.2. Using Linkset with Bookmarks

This example also uses the Linkset format [\[RFC9264\]](#) and lists the API endpoints in an array of bookmarks. Each link shares the same context anchor (the well-known URI of the API catalog) and "item" [\[RFC9264\]](#) link relation (to indicate they are an item in the catalog). The intent is that by following a bookmark link, a machine client can discover the purpose and usage policy for each API; hence, the document targeted by the bookmark link should support this.

Client request:

```
GET .well-known/api-catalog HTTP/1.1
Host: example.com
Accept: application/linkset+json
```

Server response:

```
HTTP/1.1 200 OK
Date: Mon, 01 Jun 2023 00:00:01 GMT
Server: Apache-Coyote/1.1
Content-Type: application/linkset+json;
    profile="https://www.rfc-editor.org/info/rfc9727"
```

```
{ "linkset":
  [
    { "anchor": "https://www.example.com/.well-known/api-catalog",
      "item": [
        { "href": "https://developer.example.com/apis/foo_api" },
        { "href": "https://developer.example.com/apis/bar_api" },
        { "href": "https://developer.example.com/apis/cantona_api" }
      ]
    }
  ]
}
```

A.3. Other API Catalog Formats

A non-exhaustive list of other API catalog document formats includes:

- An APIs.json document [\[APIsjson\]](#).
- A RESTDesc semantic description for hypermedia APIs [\[RESTdesc\]](#).
- A Hypertext Application Language document [\[HAL\]](#).
- An extension to the Schema.org WebAPI type [\[WebAPIext\]](#).

A.4. Nesting API Catalog Links

In this example, a request to the `/.well-known/api-catalog` URI returns an array of links of relation type `'api-catalog'`. This can be useful to Publishers with a large number of APIs who wish to group them in smaller catalogs (as described in [Section 5.3](#)).

Client request:

```
GET /.well-known/api-catalog HTTP/1.1
Host: example.com
Accept: application/linkset+json
```

Server response:

```
HTTP/1.1 200 OK
Date: Mon, 01 Jun 2023 00:00:01 GMT
Server: Apache-Coyote/1.1
Content-Type: application/linkset+json;
  profile="https://www.rfc-editor.org/info/rfc9727"
```

```
{
  "linkset": [
    {
      "anchor": "https://www.example.com/.well-known/api-catalog",
      "api-catalog": [
        {
          "href": "https://apis.example.com/iot/api-catalog"
        },
        {
          "href": "https://ecommerce.example.com/api-catalog"
        },
        {
          "href": "https://developer.example.com/gaming/api-catalog"
        }
      ]
    }
  ]
}
```

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Author's Address

Kevin Smith

Vodafone

Email: kevin.smith@vodafone.com

URI: <https://www.vodafone.com>