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RESTCONF Extensions to Support List Pagination
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Abstract

This document defines a mapping of the list pagination mechanism defined in [I-D.ietf-netconf-list-pagination] to RESTCONF [RFC8040].

This document updates RFC 8040, to declare "list" and "leaf-list" as valid resource targets for the RESTCONF GET and DELETE operations, to define GET query parameters necessary for list pagination, and to define a media-type for XML-based lists.

Status of This Memo

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Table of Contents

1. Introduction 2
  1.1. Terminology 3
  1.2. Conventions 3
2. Updates to RFC 8040 3
  2.1. Resource Targets 3
  2.2. Media Type 3
  2.3. Query Parameters 4
    2.3.1. The "limit" Query Parameter 5
    2.3.2. The "offset" Query Parameter 5
    2.3.3. The "direction" Query Parameter 5
    2.3.4. The "sort-by" Query Parameter 6
    2.3.5. The "where" Query Parameter 6
    2.3.6. The "sublist-limit" Query Parameter 6
3. IANA Considerations 6
  3.1. The "RESTCONF Capability URNs" Registry 6
  3.2. The "Media Types" Registry 7
    3.2.1. Media Type "application/yang-data+xml-list" 7
4. Security Considerations 8
5. References 8
  5.1. Normative References 8
  5.2. Informative References 9
Appendix A. Example YANG Module 9
Appendix B. Example Data Set 9
Appendix C. Example Queries 9
  C.1. List pagination with all query parameters 9
  C.2. Deletion of a leaf-list 11
Acknowledgements 11
Authors' Addresses 11

1. Introduction

This document defines a mapping of the list pagination mechanism defined in [I-D.ietf-netconf-list-pagination] to RESTCONF [RFC8040].

This document updates RFC 8040, as described in Section 2.

Declaring "list" and "leaf-list" as valid resource targets for the GET operation is necessary for list pagination. Declaring these nodes as valid resource targets for the DELETE operation merely completes the solution for RESTCONF.

1.1. 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 BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

1.2. Conventions

Various examples used in this document use a placeholder value for binary data that has been base64 encoded (e.g., "BASE64VALUE="). This placeholder value is used as real base64 encoded structures are often many lines long and hence distracting to the example being presented.

2. Updates to RFC 8040

2.1. Resource Targets

This document extends Section 3.5 of [RFC8040] to add "list" and "leaf-list" nodes (not just their entries) as valid data resources for the "GET" and "DELETE" operations.

2.2. Media Type

This document extends Section 3.2 of [RFC8040] to add a new media type, "application/yang-data+xml-list", to encode "list" and "leaf-list" nodes in XML.

The "application/yang-data+xml-list" media-type defines a pseudo top-level element called "xml-list" that is used to wrap the response set, thus ensuring that a single top-level element is returned for the XML encoding", as required by Section 4.3 of [RFC8040].

For JSON, the existing "application/yang-data+json" media type is sufficient, as the JSON format has built-in support for encoding arrays.

The "application/yang-data+xml-list" media type is registered in Section 3.2.1.

2.3. Query Parameters

This document extends Section 4.8 of [RFC8040] to add new query parameters "limit", "offset", "direction", "sort-by", "where", and "sublist-list".

These six query parameters correspond to those defined in Sections 3.1 and 3.2 in [I-D.ietf-netconf-list-pagination].

Name	Methods	Description
limit	GET, HEAD	Limits the number of entries returned. If not specified, the number of entries that may be returned is unbounded.
offset	GET, HEAD	Indicates the number of entries in the result set that should the skipped over when preparing the response. If not specified, then no entries in the result set are skipped.
direction	GET, HEAD	Indicates the direction that the result set is to be traversed. If not specified, then the result set is traversed in the "forwards" direction.
sort-by	GET, HEAD	Indicates the node name that the result set should be sorted by. If not specified, then the result set's default order is used, per YANG's "ordered-by" statement.
where	GET, HEAD	Specifies a filter expression that result set entries must match. If not specified, then no entries are filtered from the result set.
sublist-limit	GET, HEAD	Limits the number of entries returned returned for descendent lists and leaf-lists. If not specified, the number of entries that may be returned is unbounded.

For all of the query parameters, the query parameter is only allowed for the GET and HEAD methods on "list" and "leaf-list" data resources. A "400 Bad Request" status-line MUST be returned if used with any other method or resource type. The error-tag value "operation-not-supported" is used in this case.

Per the conformance defined in Section 3.1 of [I-D.ietf-netconf-list-pagination], all of these parameters MUST be supported for all lists and leaf-lists, but servers MAY disable the support for some or all "config false" lists, as described in Section 3.3 of [I-D.ietf-netconf-list-pagination].

2.3.1. The "limit" Query Parameter

The "limit" query parameter corresponds to the "limit" parameter defined in Section 3.1.5 of [I-D.ietf-netconf-list-pagination].

If the limit value is invalid, then a "400 Bad Request" status-line MUST be returned with the error-type value "application" and error-tag value "invalid-value".

2.3.2. The "offset" Query Parameter

The "offset" query parameter corresponds to the "offset" parameter defined in Section 3.1.4 of [I-D.ietf-netconf-list-pagination].

If the offset value is invalid, a "400 Bad Request" status-line MUST be returned with the error-type value "application" and error-tag value "invalid-value".

If the offset value exceeds the number of entries in the working result set, then a "416 Range Not Satisfiable" status-line MUST be returned with the error-type value "application", error-tag value "invalid-value", and SHOULD also include the "offset-out-of-range" identity as error-app-tag value.

2.3.3. The "direction" Query Parameter

The "direction" query parameter corresponds to the "direction" parameter defined in Section 3.1.3 of [I-D.ietf-netconf-list-pagination].

If the direction value is invalid, then a "400 Bad Request" status-line MUST be returned with the error-type value "application" and error-tag value "invalid-value".

2.3.4. The "sort-by" Query Parameter

The "sort-by" query parameter corresponds to the "sort-by" parameter defined in Section 3.1.2 of [I-D.ietf-netconf-list-pagination].

If the specified node identifier is invalid, then a "400 Bad Request" status-line MUST be returned with the error-type value "application" and error-tag value "invalid-value".

2.3.5. The "where" Query Parameter

The "where" query parameter corresponds to the "where" parameter defined in Section 3.1.1 of [I-D.ietf-netconf-list-pagination].

If the specified XPath expression is invalid, then a "400 Bad Request" status-line MUST be returned with the error-type value "application" and error-tag value "invalid-value".

2.3.6. The "sublist-limit" Query Parameter

The "sublist-limit" query parameter corresponds to the "sublist-limit" parameter defined in Section 3.2.1 of [I-D.ietf-netconf-list-pagination].

If the sumlist-limit value is invalid, then a "400 Bad Request" status-line MUST be returned with the error-type value "application" and error-tag value "invalid-value".

3. IANA Considerations

3.1. The "RESTCONF Capability URNs" Registry

This document registers six capabilities in the RESTCONF Capability URNs [RFC8040] maintained at https://www.iana.org/assignments/restconf-capability-urns/restconf-capability-urns.xhtml. Following the instructions defined in Section 11.4 of [RFC8040], the below registrations are requested:

All the registrations are to use this document (RFC XXXX) for the "Reference" value.

Index	Capability Identifier
:limit	urn:ietf:params:restconf:capability:limit:1.0
:offset	urn:ietf:params:restconf:capability:offset:1.0
:direction	urn:ietf:params:restconf:capability:direction:1.0
:sort-by	urn:ietf:params:restconf:capability:sort-by:1.0
:where	urn:ietf:params:restconf:capability:where:1.0
:sublist-limit	urn:ietf:params:restconf:capability:sublist-limit:1.0

3.2. The "Media Types" Registry

This document registers one media type in the "application" subregistry of the Media Types registry [RFC6838] [RFC4855] maintained at https://www.iana.org/assignments/media-types/media-types.xhtml#application. Following the format defined in [RFC4855], the below registration is requested:

3.2.1. Media Type "application/yang-data+xml-list"

Type name: application

Subtype name: yang-data+xml-list

Required parameters: None

Optional parameters: None

Encoding considerations: 8-bit
Each conceptual YANG data node is encoded according to the XML Encoding Rules and Canonical Format for the specific YANG data node type defined in [RFC7950].

Security considerations: Security considerations related to the generation and consumption of RESTCONF messages are discussed in Section 12 of RFC 8040. Additional security considerations are specific to the semantics of particular YANG data models. Each YANG module is expected to specify security considerations for the YANG data defined in that module.

Interoperability considerations: RFC XXXX specifies the format of conforming messages and the interpretation thereof.

Published specification: RFC XXXX

Applications that use this media type: Instance document data parsers used within a protocol or automation tool that utilize the YANG Patch data structure.

Fragment identifier considerations: Fragment identifiers for this type are not defined. All YANG data nodes are accessible as resources using the path in the request URI.

Additional information:

Deprecated alias names for this type: N/A
Magic number(s): N/A
File extension(s): None
Macintosh file type code(s): "TEXT"

Person & email address to contact for further information:
See the Authors' Addresses section of RFC XXXX.

Intended usage: COMMON

Restrictions on usage: N/A

Author: See the Authors' Addresses section of RFC XXXX.

Change controller: Internet Engineering Task Force
(mailto:iesg@ietf.org).

Provisional registration? (standards tree only): no

4. Security Considerations

This document introduces protocol operations for paging through data already provided by the RESTCONF protocol, and hence does not introduce any new security considerations.

This document does not define a YANG module and hence there are no data modeling considerations beyond those discussed in [I-D.ietf-netconf-list-pagination].

5. References

5.1. Normative References

[I-D.ietf-netconf-list-pagination]
"List Pagination...", <FIXME>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <https://www.rfc-editor.org/info/rfc8040>.

[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>.

5.2. Informative References

[I-D.ietf-netconf-restconf-collection] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Collection Resource", Work in Progress, Internet-Draft, draft-ietf-netconf-restconf-collection-00, 30 January 2015, <https://www.ietf.org/archive/id/draft-ietf-netconf-restconf-collection-00.txt>.

[RFC4855] Casner, S., "Media Type Registration of RTP Payload Formats", RFC 4855, DOI 10.17487/RFC4855, February 2007, <https://www.rfc-editor.org/info/rfc4855>.

[RFC6838] Freed, N., Klensin, J., and T. Hansen, "Media Type Specifications and Registration Procedures", BCP 13, RFC 6838, DOI 10.17487/RFC6838, January 2013, <https://www.rfc-editor.org/info/rfc6838>.

Appendix A. Example YANG Module

The examples within this document use the "example-social" YANG module defined in Appendix A.1 of [I-D.ietf-netconf-list-pagination].

Appendix B. Example Data Set

The Example Data Set used by the examples is defined in Appendix A.2 of [I-D.ietf-netconf-list-pagination].

Appendix C. Example Queries

C.1. List pagination with all query parameters

This example mimics that Appendix A.3.7 of [I-D.ietf-netconf-list-pagination].

```
=============== NOTE: '\' line wrapping per RFC 8792 ================

GET /restconf/ds/ietf-datastores:running/example-social:members/memb\
er?where=//stats//joined[starts-with(@timestamp,'2020')]&sort-by=tim\
estamp&direction=backwards&offset=2&limit=2&sublist-limit=1  HTTP/1.1
Host: example.com
Accept: application/yang-data+xml-list
```

Response from the RESTCONF server:

```
=============== NOTE: '\' line wrapping per RFC 8792 ================

HTTP/1.1 200 OK
Date: Thu, 26 Jan 2017 20:56:30 GMT
Server: example-server
Last-Modified: Thu, 26 Jan 2017 20:55:30 GMT
Content-Type: application/yang-data+xml-list

<lp:xml-list xmlns:lp="urn:ietf:params:xml:ns:yang:ietf-restconf-lis\
t-pagination"
  xmlns="http://example.com/ns/example-social">
  <member lp:remaining="1">
    <member-id>eric</member-id>
    <email-address>eric@example.com</email-address>
    <password>$0$1543</password>
    <avatar>BASE64VALUE=</avatar>
    <tagline>Go to bed with dreams; wake up with a purpose.</tagline>
    <following>alice</following>
    <posts>
      <post>
        <timestamp>2020-09-17T18:02:04Z</timestamp>
        <title>Son, brother, husband, father</title>
        <body>What's your story?</body>
      </post>
    </posts>
    <favorites>
      <bits lp:remaining="2">two</bits>
    </favorites>
    <stats>
      <joined>2020-09-17T19:38:32Z</joined>
      <membership-level>pro</membership-level>
      <last-activity>2020-09-17T18:02:04Z</last-activity>
    </stats>
  </member>
  <member lp:remaining="1">
    <member-id>bob</member-id>
    <email-address>bob@example.com</email-address>
    <password>$0$1543</password>
    <avatar>BASE64VALUE=</avatar>
    <tagline>Here and now, like never before.</tagline>
    <posts>
      <post lp:remaining="2">
        <timestamp>2020-08-14T03:32:25Z</timestamp>
        <body>Just got in.</body>
      </post>
    </posts>
    <favorites>
      <decimal64-numbers lp:remaining="1">3.14159</bits>
    </favorites>
    <stats>
      <joined>2020-08-14T03:30:00Z</joined>
      <membership-level>standard</membership-level>
      <last-activity>2020-08-14T03:34:30Z</last-activity>
    </stats>
  </member>
</lp:xml-list>
```

C.2. Deletion of a leaf-list

This example illustrates using a "leaf-list" as the DELETE target.

```
=============== NOTE: '\' line wrapping per RFC 8792 ================

DELETE /restconf/ds/ietf-datastores:running/example-social:members/m\
ember=bob/favorites/decimal64-numbers HTTP/1.1
Host: example.com
Accept: application/yang-data+xml
```

Response from the RESTCONF server:

```
HTTP/1.1 204 No Content
Date: Thu, 26 Jan 2017 20:56:30 GMT
Server: example-server
```

Acknowledgements

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