

NETCONF Working Group  
Internet-Draft  
Intended status: Standards Track  
Expires: 28 April 2022

K. Watsen  
Watsen Networks  
Q. Wu  
Huawei  
O. Hagsand  
Netgate  
H. Li  
HPE  
P. Andersson  
Cisco Systems  
25 October 2021

NETCONF Extensions to Support List Pagination  
draft-wwlh-netconf-list-pagination-nc-02

Abstract

This document defines a mapping of the list pagination mechanism defined in [[I-D.wwlh-netconf-list-pagination](#)] to NETCONF [[RFC6241](#)].

This document updates [[RFC6241](#)], to augment the <get> and <get-config> "rpc" statements, and [[RFC8526](#)], to augment the <get-data> "rpc" statement, to define input parameters necessary for list pagination.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on 28 April 2022.

Copyright Notice

Copyright (c) 2021 IETF Trust and the persons identified as the document authors. All rights reserved.

Internet-Draft

NETCONF Pagination Support

October 2021

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the [Trust Legal Provisions](#) and are provided without warranty as described in the Simplified BSD License.

## Table of Contents

<a href="#">1.</a>	Introduction . . . . .	<a href="#">2</a>
<a href="#">1.1.</a>	Terminology . . . . .	<a href="#">3</a>
<a href="#">1.2.</a>	Conventions . . . . .	<a href="#">3</a>
<a href="#">2.</a>	Updates to NETCONF operations . . . . .	<a href="#">3</a>
<a href="#">2.1.</a>	Updates to <a href="#">RFC 6241</a> . . . . .	<a href="#">3</a>
<a href="#">2.2.</a>	Updates to <a href="#">RFC 8526</a> . . . . .	<a href="#">3</a>
<a href="#">3.</a>	List Pagination for NETCONF . . . . .	<a href="#">3</a>
<a href="#">4.</a>	Error Reporting . . . . .	<a href="#">4</a>
<a href="#">5.</a>	YANG Module for List Pagination in NETCONF . . . . .	<a href="#">5</a>
<a href="#">6.</a>	IANA Considerations . . . . .	<a href="#">7</a>
<a href="#">6.1.</a>	The "IETF XML" Registry . . . . .	<a href="#">7</a>
<a href="#">6.2.</a>	The "YANG Module Names" Registry . . . . .	<a href="#">7</a>
<a href="#">7.</a>	Security Considerations . . . . .	<a href="#">8</a>
<a href="#">7.1.</a>	The "ietf-netconf-list-pagination" YANG Module . . . . .	<a href="#">8</a>
<a href="#">8.</a>	References . . . . .	<a href="#">8</a>
<a href="#">8.1.</a>	Normative References . . . . .	<a href="#">8</a>
<a href="#">8.2.</a>	Informative References . . . . .	<a href="#">9</a>
<a href="#">Appendix A.</a>	Open Issues . . . . .	<a href="#">10</a>
<a href="#">Appendix B.</a>	Example YANG Module . . . . .	<a href="#">10</a>
<a href="#">Appendix C.</a>	Example Data Set . . . . .	<a href="#">10</a>
<a href="#">Appendix D.</a>	Example Queries . . . . .	<a href="#">10</a>
<a href="#">D.1.</a>	List pagination with all query parameters . . . . .	<a href="#">10</a>
	Acknowledgements . . . . .	<a href="#">12</a>
	Authors' Addresses . . . . .	<a href="#">12</a>

## [1.](#) Introduction

This document defines a mapping of the list pagination mechanism defined in [[I-D.wvlh-netconf-list-pagination](#)] to NETCONF [[RFC6241](#)].

This document updates [[RFC6241](#)] and [[RFC8526](#)], as described in [Section 2](#).

While the pagination mechanism defined in this document is designed for the NETCONF protocol [[RFC6241](#)], the augmented RPCs MAY be used by the RESTCONF protocol [[RFC8040](#)] if the RESTCONF server implements the "ietf-list-pagination-nc" module.

The YANG data model in this document conforms to the Network Management Datastore Architecture defined in [[RFC8342](#)]

### [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 NETCONF operations

### [2.1.](#) Updates to [RFC 6241](#)

The <get> and <get-config> rpc statements are augmented to accept additional input parameters, as described in [Section 3](#).

### [2.2.](#) Updates to [RFC 8526](#)

The <get-data> rpc statement is augmented to accept additional input parameters, as described in [Section 3](#).

## [3.](#) List Pagination for NETCONF

In order for NETCONF to support [[I-D.wwlh-netconf-list-pagination](#)], this document extends the operations <get>, <get-config> and <get-data> to include additional input parameters and output annotations.

The updated operations accept a content filter parameter, similar to the "filter" parameter of <get-config>, but includes nodes for "list" and "leaf-list" filtering.

The content filter parameter is used to specify the YANG list or leaf-list that is to be retrieved. This must be a path expression used to represent a list or leaf-list data node.

The following tree diagram [[RFC8340](#)] illustrates the "ietf-netconf-list-pagination" module:

```
module: ietf-list-pagination-nc

augment /nc:get/nc:input:
  +---w list-pagination
    +---w where?          union
    +---w sort-by?        union
    +---w direction?      enumeration
    +---w offset?         uint32
    +---w limit?          union
    +---w sublist-limit?  union
augment /nc:get-config/nc:input:
  +---w list-pagination
    +---w where?          union
    +---w sort-by?        union
    +---w direction?      enumeration
    +---w offset?         uint32
    +---w limit?          union
    +---w sublist-limit?  union
augment /ncds:get-data/ncds:input:
  +---w list-pagination
    +---w where?          union
    +---w sort-by?        union
    +---w direction?      enumeration
    +---w offset?         uint32
    +---w limit?          union
    +---w sublist-limit?  union
```

Comments:

- \* This module augments three NETCONF "rpc" statements: get, get-config, and get-data.
- \* The "get" and "get-config" augments are against the YANG module defined in [[RFC6241](#)]. The "get-data" augment is against the YANG module defined in [[RFC8526](#)].

#### [4.](#) Error Reporting

When an input query parameter is supplied with an erroneous value, an <rpc-error> MUST be returned containing the error-type value "application", the error-tag value "invalid-value", and MAY include the error-severity value "error". Additionally the error-app-tag SHOULD be set containing query parameter specific error value.

##### [4.1.](#) The "offset" Query Parameter

If the "offset" query parameter value supplied is larger then the number of instances in the list or leaf-list target resource, the <rpc-error> MUST contain error-app-tag with value "offset-out-of-range".

#### [5.](#) YANG Module for List Pagination in NETCONF

The "ietf-netconf-list-pagination-nc" module defines conceptual definitions within groupings, which are not meant to be implemented as datastore contents by a server.

This module has normative references to [[RFC6241](#)], [[RFC6243](#)], [[RFC6991](#)], and [[RFC8342](#)].

<CODE BEGINS> file "ietf-list-pagination-nc@2021-10-25.yang"

```
module ietf-list-pagination-nc {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-list-pagination-nc";
  prefix lpgnc;
```

```

import ietf-netconf {
  prefix nc;
  reference
    "RFC 6241: Network Configuration Protocol (NETCONF)";
}

import ietf-netconf-nmda {
  prefix ncds;
  reference
    "RFC 8526: NETCONF Extensions to Support the
      Network Management Datastore Architecture";
}

import ietf-list-pagination {
  prefix lp;
  reference
    "RFC XXXX: List Pagination for YANG-driven Protocols";
}

organization
  "IETF NETCONF (Network Configuration) Working Group";

contact
  "WG Web:  <http://tools.ietf.org/wg/netconf/>
   WG List: <mailto:netconf@ietf.org>";

```

#### description

"This module augments the <get>, <get-config>, and <get-data> 'rpc' statements to support list pagination.

Copyright (c) 2021 IETF Trust and the persons identified as authors of the code. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in [Section 4.c](#) of the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>).

This version of this YANG module is part of RFC XXXX

(<https://www.rfc-editor.org/info/rfcXXXX>); see the RFC itself for full legal notices.

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](#) ([RFC 2119](#)) ([RFC 8174](#)) when, and only when, they appear in all capitals, as shown here.";

```
revision 2021-10-25 {
  description
    "Initial revision.";
  reference
    "RFC XXXX: NETCONF Extensions to Support List Pagination";
}
```

```
grouping pagination-parameters {
  description "A grouping for list pagination parameters.";
  container list-pagination {
    description "List pagination parameters.";
    uses lp:where-param-grouping;
    uses lp:sort-by-param-grouping;
    uses lp:direction-param-grouping;
    uses lp:offset-param-grouping;
    uses lp:limit-param-grouping;
    uses lp:sublist-limit-param-grouping;
  }
}
```

```
augment "/nc:get/nc:input" {
  description
    "Allow the 'get' operation to use content filter
```

```
    parameter for specifying the YANG list or leaf-list
    that is to be retrieved";
  uses pagination-parameters;
}

augment "/nc:get-config/nc:input" {
  description
    "Allow the 'get-config' operation to use content filter
```

```

        parameter for specifying the YANG list or leaf-list
        that is to be retrieved";
    uses pagination-parameters;
}

augment "/ncds:get-data/ncds:input" {
    description
        "Allow the 'get-data' operation to use content filter
        parameter for specifying the YANG list or leaf-list
        that is to be retrieved";
    uses pagination-parameters;
}
}

<CODE ENDS>

```

## [6.](#) IANA Considerations

### [6.1.](#) The "IETF XML" Registry

This document registers one URI in the "ns" subregistry of the IETF XML Registry [[RFC3688](#)] maintained at <https://www.iana.org/assignments/xml-registry/xml-registry.xhtml#ns>. Following the format in [[RFC3688](#)], the following registration is requested:

URI: urn:ietf:params:xml:ns:yang:ietf-list-pagination-nc  
 Registrant Contact: The IESG.  
 XML: N/A, the requested URI is an XML namespace.

### [6.2.](#) The "YANG Module Names" Registry

This document registers one YANG module in the YANG Module Names registry [[RFC6020](#)] maintained at <https://www.iana.org/assignments/yang-parameters/yang-parameters.xhtml>. Following the format defined in [[RFC6020](#)], the below registration is requested:



namespace: urn:ietf:params:xml:ns:yang:ietf-list-pagination-nc  
prefix: pgnc  
RFC: XXXX

## [7.](#) Security Considerations

### [7.1.](#) The "ietf-netconf-list-pagination" YANG Module

The YANG module defined in this document extends the base operations for NETCONF [[RFC6241](#)] and RESTCONF [[RFC8040](#)]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [[RFC6242](#)]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [[RFC8446](#)].

The Network Configuration Access Control Model (NACM) [[RFC8341](#)] provides the means to restrict access for particular NETCONF users to a preconfigured subset of all available NETCONF protocol operations and content.

The security considerations for the base NETCONF protocol operations (see [Section 9 of \[RFC6241\]](#)) apply to the new <get-list-pagination> RPC operations defined in this document.

## [8.](#) References

### [8.1.](#) Normative References

- [I-D.wwlh-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>>.
- [RFC3688] Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#), DOI 10.17487/RFC3688, January 2004, <<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", [RFC 6020](#), DOI 10.17487/RFC6020, October 2010, <<https://www.rfc-editor.org/info/rfc6020>>.

- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", [RFC 6241](#), DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", [RFC 6242](#), DOI 10.17487/RFC6242, June 2011, <<https://www.rfc-editor.org/info/rfc6242>>.
- [RFC6243] Bierman, A. and B. Lengyel, "With-defaults Capability for NETCONF", [RFC 6243](#), DOI 10.17487/RFC6243, June 2011, <<https://www.rfc-editor.org/info/rfc6243>>.
- [RFC6991] Schoenwaelder, J., Ed., "Common YANG Data Types", [RFC 6991](#), DOI 10.17487/RFC6991, July 2013, <<https://www.rfc-editor.org/info/rfc6991>>.
- [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>>.
- [RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, [RFC 8341](#), DOI 10.17487/RFC8341, March 2018, <<https://www.rfc-editor.org/info/rfc8341>>.
- [RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "Network Management Datastore Architecture (NMDA)", [RFC 8342](#), DOI 10.17487/RFC8342, March 2018, <<https://www.rfc-editor.org/info/rfc8342>>.
- [RFC8526] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "NETCONF Extensions to Support the Network Management Datastore Architecture", [RFC 8526](#), DOI 10.17487/RFC8526, March 2019, <<https://www.rfc-editor.org/info/rfc8526>>.

## [8.2](#). Informative References

- [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>>.
- [RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", [BCP 215](#), [RFC 8340](#), DOI 10.17487/RFC8340, March 2018, <<https://www.rfc-editor.org/info/rfc8340>>.

Internet-Draft

NETCONF Pagination Support

October 2021

[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>>.

## [Appendix A](#). Open Issues

Cursors (i.e., stable result sets) are related to the topic of dynamic changing lists between two queries. How cursors can be supported using "feature"?

## [Appendix B](#). Example YANG Module

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

## [Appendix C](#). Example Data Set

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

## [Appendix D](#). Example Queries

### [D.1](#). List pagination with all query parameters

This example mimics that [Appendix A.3.7](#) of [[I-D.wwlh-netconf-list-pagination](#)].

===== NOTE: '\ ' line wrapping per [RFC 8792](#) =====

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="42">
  <get-config>
    <source>
      <running/>
    </source>
    <filter type="xpath" select="/es:members/es:member"
      xmlns:es="http://example.com/ns/example-social"/>
      <list-pagination
        xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-list-paginat\
ion">true</list-pagination>
```

```

    <where>//stats//joined[starts-with(@timestamp,'2020')]</where>
    <sort-by>timestamp</sort-by>
    <direction>backwards</direction>
    <offset>2</offset>
    <limit>2</limit>
    <sublist-limit>1</sublist-limit>
  </filter>
</get-config>
</rpc>

```

Response from the NETCONF server:

===== NOTE: '\ ' line wrapping per [RFC 8792](#) =====

```

<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>

```

## Acknowledgements

This work has benefited from the discussions of RESTCONF resource collection over the years, in particular, [I-D.ietf-netconf-restconf-collection] which provides enhanced filtering features for the retrieval of data nodes with the GET method and [I-D.zheng-netconf-fragmentation] which document large size data handling challenge. The authors would like to thank the following for lively discussions on list:

Andy Bierman Martin Björklund Robert Varga

## Authors' Addresses

Kent Watsen  
Watsen Networks

Email: kent+ietf@watsen.net

Qin Wu  
Huawei  
101 Software Avenue, Yuhua District  
Nanjing  
Jiangsu, 210012  
China

Email: [bill.wu@huawei.com](mailto:bill.wu@huawei.com)

Olof Hagsand  
Netgate

Email: [olof@hagsand.se](mailto:olof@hagsand.se)

Hongwei Li  
HPE

Email: [flycoolman@gmail.com](mailto:flycoolman@gmail.com)

Per Andersson  
Cisco Systems

Email: [perander@cisco.com](mailto:perander@cisco.com)

