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NETCONF Extensions to Support List Pagination  
draft-ietf-netconf-list-pagination-nc-07

Abstract

This document defines a mapping of the list pagination mechanism defined in [I-D.ietf-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.

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## 1. Introduction

This document defines a mapping of the list pagination mechanism defined in [I-D.ietf-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 in this document use "BASE64VALUE=" as a placeholder value for binary data that has been base64 encoded (per Section 9.8 of [RFC7950]). This placeholder value is used because 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 in Section 3.

## 3. List Pagination for NETCONF

In order for NETCONF to support [I-D.ietf-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 locale?         string {sort}?
    +---w sort-by?        union {sort}?
    +---w direction?      enumeration
    +---w cursor?         string
    +---w offset?         uint32
    +---w limit?          union
    +---w sublist-limit?  union
augment /nc:get-config/nc:input:
  +---w list-pagination
    +---w where?          union
    +---w locale?         string {sort}?
    +---w sort-by?        union {sort}?
    +---w direction?      enumeration
    +---w cursor?         string
    +---w offset?         uint32
    +---w limit?          union
    +---w sublist-limit?  union
augment /ncds:get-data/ncds:input:
  +---w list-pagination
    +---w where?          union
    +---w locale?         string {sort}?
    +---w sort-by?        union {sort}?
    +---w direction?      enumeration
    +---w cursor?         string
    +---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 than the number of instances in the working result-set, 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@2025-04-03.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 lpg;
    reference
      "RFC XXXX: List Pagination for YANG-driven Protocols";
  }
}
```

## organization

"IETF NETCONF (Network Configuration) Working Group";

## contact

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## description

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

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(<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 2025-04-03 {

```
    description
      "Initial revision.";
    reference
      "RFC XXXX: NETCONF Extensions to Support List Pagination";
  }

  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 lpg: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 lpg: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 lpg: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:

```
name: ietf-list-pagination-nc
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

This section follows the template defined in Section 3.7.1 of [RFC8407].

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or 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] and Section 6 of [RFC8526]) apply to the extension of operations <get>, <get-config>, and <get-data> defined in this document.

## 8. References

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## 8.2. Informative References

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Zheng, G. and Z. Wang, "A NETCONF Extension for Data Fragmentation", Work in Progress, Internet-Draft, draft-zheng-netconf-fragmentation-02, 26 June 2018, <<https://datatracker.ietf.org/doc/html/draft-zheng-netconf-fragmentation-02>>.

## 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.3.9 of [I-D.ietf-netconf-list-pagination].

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="42">
  <get>
    <source>
      <running/>
    </source>
    <filter type="xpath" select="/es:members/es:member"
      xmlns:es="https://example.com/ns/example-social"/>
    <list-pagination
      xmlns="urn:ietf:params:xml:ns:yang:ietf-list-pagination-nc">
      <where>//stats[starts-with(joined,'2020')]</where>
      <sort-by>joined</sort-by>
      <direction>backwards</direction>
      <offset>2</offset>
      <limit>2</limit>
      <sublist-limit>1</sublist-limit>
      <locale>sv_US</locale>
    </list-pagination>
  </get>
</rpc>
```

Response from the NETCONF server:

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

```
<rpc-reply message-id="101"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <data>
    <members
      xmlns="https://example.com/ns/example-social"
      xmlns:lp="urn:ietf:params:xml:ns:yang:ietf-list-pagination">
      <member lp:remaining="1" lp:locale="en_US">
        <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 purpose.</tagline>
```

```
ne>
  <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" lp:locale="en_US">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" lp:locale="en_US">
  <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" lp:locale="en_US">
      <timestamp>2020-08-14T03:32:25Z</timestamp>
      <body>Just got in.</body>
    </post>
  </posts>
  <favorites>
    <decimal64-numbers lp:remaining="1" lp:locale="en_US">3.14\
159</decimal64-numbers>
  </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>
</members>
</data>
</rpc-reply>
```

## 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 (ordered by first name): Andy Bierman, Martin Björklund, Robert Varga, and Robert Wilton.

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