

Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: April 12, 2013

A. Bierman
YumaWorks
October 9, 2012

The NETCONF <get2> Operation
draft-bierman-netconf-get2-02

Abstract

This document describes NETCONF protocol enhancements to improve data retrieval capabilities.

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 <http://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 April 12, 2013.

Copyright Notice

Copyright (c) 2012 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://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.

Internet-Draft

<get2>

October 2012

Table of Contents

1.	Introduction	3
1.1.	Problem Statement	3
1.1.1.	Wrong Data Type Returned	3
1.1.2.	No Last-Modified Indication or Time Filtering	3
1.1.3.	No Simple Instance Discovery Mechanism	3
1.1.4.	No Subtree Depth Control	4
1.1.5.	Content Filter Specification is not Extensible	4
1.1.6.	Source of Operational Data Unknown	4
1.2.	Solution	5
1.3.	Terminology	5
1.3.1.	NETCONF	5
1.3.2.	YANG	5
1.3.3.	Terms	6
2.	<get2> Operation	7
2.1.	Depth Filters	7
2.2.	Time Filters	8
3.	Operational Data Source Reporting	9
3.1.	Identifying Data Sources	9
4.	XSD for the "last-modified" Attribute	10
5.	XSD for the "data-source" Attribute	11
6.	data-source YANG Module	12
7.	<get2> YANG Module	15
8.	IANA Considerations	21
9.	Security Considerations	22
10.	Change Log	23
10.1.	00-01	23
10.2.	01-02	23
11.	References	24
11.1.	Normative References	24
11.2.	Informative References	24
Appendix A.	Examples	25
A.1.	YANG Module Used in Examples	25
A.2.	YANG Data Used in Examples	26
A.3.	Example: Operational Datastore	26
A.4.	Example: If-Modified-Since Non-Empty Filter Retrieval	28
A.5.	Example: If-Modified-Since Empty Filter Retrieval	29
A.6.	Example: Keys Only Filter Retrieval	30
A.7.	Example: Testing for Node Existence with Depth=1	31
A.8.	Example: Keys Only Filter Retrieval with Depth=3	32
A.9.	Example: Operational Data Sources (tree height)	33
A.10.	Example: Operational Data Sources (ietf-system)	35

Internet-Draft

<get2>

October 2012

[1.](#) Introduction

There is a need for standard mechanisms to allow NETCONF [[RFC6241](#)] application designers to retrieve data from NETCONF servers more efficiently.

[1.1.](#) Problem Statement

This document attempts to address the following problems with NETCONF data retrieval mechanisms.

[1.1.1.](#) Wrong Data Type Returned

The NETCONF <get> operation allows a client to retrieve data from the server but it returns all data, including configuration datastore nodes. The <get-config> operation already returns all configuration datastore nodes.

It was originally thought that <get> should return all nodes so the client would not have to correlate configuration and non-configuration data nodes, since they would be mixed together in the reply.

Operational experience has shown that the <get> operation without reasonable filters to reduce the returned data can significantly degrade device performance and return enormous XML instance documents in the <rpc-reply>.

[1.1.2.](#) No Last-Modified Indication or Time Filtering

The NETCONF protocol has no standard mechanisms to indicate to a client when a datastore was last modified, or to allow a client to retrieve data only if it has been modified since a specified time. This makes polling applications very inefficient because they will regularly burden the server and the network and themselves with retrieval and processing requests for data that has not changed.

[1.1.3.](#) No Simple Instance Discovery Mechanism

Sometimes the client application wants to discover what data exists on the server, particularly list entries. There is a need for a simple mechanism to retrieve just the key leaf nodes within a subtree.

The NETCONF subtree filtering mechanism does provide a very complex way for the client to request just key leafs for specific list entries. A simpler mechanism is needed which will allow the client to discover the list instances present.

Bierman

Expires April 12, 2013

[Page 3]

Internet-Draft

<get2>

October 2012

[1.1.4.](#) No Subtree Depth Control

NETCONF filters allow the client to select specific sub-trees within the conceptual datastore on the server. However, sometimes the client does not really need the entire subtree, which may contain many nested list entries, and be very large.

There is sometimes a need to limit the depth of the sub-trees retrieved from the server. A consistent and simple algorithm for determining what data nodes start a new level is needed.

[1.1.5.](#) Content Filter Specification is not Extensible

The NETCONF <get> and <get-config> operations use a hard-coded content filtering mechanism. They use a "type" XML attribute to indicate which of two filter specification types they support, and a "select" XML attribute if the :xpath capability is supported and an XPath [[XPATH](#)] expression filter specification is provided.

This design does not allow additional content filter specification types to be supported by an implementation. It does not allow the standard to be easily extended in a modular fashion.

In addition, this design does not allow YANG statements to be used to properly describe the protocol operation. The special "get-filter-element-attributes" YANG extension in the ietf-netconf module is not extensible, and it does not really count as proper YANG, since this extension is outside the YANG language definition.

[1.1.6.](#) Source of Operational Data Unknown

The operational data nodes returned by the server can sometimes represent server state parameters which may be derived from different sources.

For example, an operational node representing the current date and time in use on a system might be derived from the Network Time Protocol (NTP) or from an action operation to set the current time.

A list representing a routing entries in use in a router might include entries learned from a routing protocol and entries statically configured in the running datastore.

There is a need for standard mechanisms to:

- o identify data-model specific sources of operational data.

- o identify which nodes in a datastore that the server should maintain data source information
- o allow the client to retrieve the data source information.

[1.2.](#) Solution

This document defines a new NETCONF protocol operation called <get2> to address the deficiencies described in the previous section. It can be implemented existing NETCONF servers without requiring a change in the protocol version.

[1.3.](#) Terminology

The keywords "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](#)].

[1.3.1.](#) NETCONF

The following terms are defined in [[RFC6241](#)]:

- o candidate configuration datastore
- o client
- o configuration data
- o datastore
- o configuration datastore
- o protocol operation
- o running configuration datastore
- o server
- o startup configuration datastore

1.3.2. YANG

The following terms are defined in [[RFC6020](#)]:

- o anyxml

- o container
- o data node
- o key leaf
- o leaf
- o leaf-list
- o list
- o presence container (or P-container)
- o non-presence container (or NP-container)

[1.3.3.](#) Terms

The following terms are defined:

- o non-configuration data node: a data node which is not a configuration data node, i.e. config=false.
- o operational datastore: the collection of all conceptual YANG data nodes which represent non-configuration data. This conceptual datastore also includes ancestor container and list nodes for any nested non-configuration data nodes, as well as list keys for any list data nodes in this datastore.
- o operational data node: A data node which is contained within the operational datastore. Ancestor container, list, and key leaf nodes for any nested non-configuration nodes are only operational data nodes if they are also non-configuration data nodes.
- o depth filter: A mechanism implemented within the NETCONF server to allow a client to retrieve only a limited number of levels within the a subtree, instead of retrieving the entire subtree.
- o time filter: A mechanism implemented within the NETCONF server to allow a client to retrieve only data that has been modified since a specified data and time.

[2.](#) <get2> Operation

The <get2> operation is defined with a YANG "rpc" statement. A specific datastore is selected for the source of the retrieval operation. Several different types of filters are provided. Filters are combined in a conceptual "logical-AND" operation, and are optional to use by the client. Not all filtering mechanisms are mandatory-to-implement for the server.

The <get2> protocol operation contains the following input parameters:

- o source: A container indicating the conceptual datastore for the retrieval request.
- o filter-spec: A choice indicating the content filter specification for the retrieval request.
- o keys-only: A leaf indicating that only the key leaves, combined with other filtering criteria, should be returned.
- o if-modified-since: A leaf indicating the time filter specification for the retrieval request, according to the procedures in [Section 2.2](#).
- o depth: A leaf indicating the subtree depth level for the retrieval request, according to the procedures in [Section 2.1](#).
- o with-defaults: A leaf indicating the type of defaults handling requested, according to procedures in [\[RFC6243\]](#).
- o with-timestamps: A leaf indicating that "last-modified" XML attributes are requested, encoded according to the schema in [Section 4](#).
- o with-data-sources: A leaf indicating that "data-source" XML attributes are requested, encoded according to the schema in [Section 5](#).

[2.1](#). Depth Filters

A depth filter indicates how many subtree levels should be returned in the <rpc-reply>. This filter is specified with the "depth" input parameter for the <get2> protocol operation. The default "0" indicates that all levels from the requested subtrees should be returned.

A new level is started for each YANG data node within the requested

subtree. All top level data nodes are considered to be child nodes

(level 1) of a conceptual <config> root.

If no content filters are provided, then level 1 is considered to include all top-level data nodes within the source datastore. Otherwise only the levels in selected subtrees will be considered, and not any additional top-level data nodes.

If the depth requested is equal to "1", then only the requested data nodes (or top-level data nodes) will be returned. This mechanism can be used to detect the existence of containers and list entries within a particular subtree, without returning any of the descendant nodes.

Higher depth values indicates the number of descendant nodes to include in the response. For example, if the depth requested is equal to "2", then only the requested data nodes (or top-level data nodes) and their immediate child data nodes will be returned.

[2.2.](#) Time Filters

A time filter indicates that only data which has been modified since the indicated date and time should be included in the reply.

If this feature is supported, then the server will maintain a last-modified timestamp for the source datastore. It MAY support additional nested timestamps for data nodes within the datastore.

When a request containing the "if-modified-since" parameter is received, the server will compare that timestamp to the last-modified timestamp for the source datastore. If it is greater than the specified value then data may be returned (depending on other filters). If the datastore timestamp value is less than or equal to the specified value, then an empty <data> element will be returned in the <rpc-reply>.

If the server maintains "last-modified" timestamps for any data nodes within the source datastore then the same type of comparison will be done for the data node to determine if it should be included in the response. If no "last-modified" timestamp is maintained for a data node, then the server will use the "last-modified" timestamp for its nearest ancestor, or for the datastore itself if there are none.

[3.](#) Operational Data Source Reporting

Operational data source reporting is supported if the server advertises the "data-source" feature.

If the "with-data-sources" parameter is present in the <get2> request, and the server supports the "data-source" feature, then data source reporting will be done for the applicable nodes.

An operational data source applies only to operational data nodes, and only if the "data-source" YANG extension statement defined in [Section 6](#) is present in the YANG data definition statement for the data node.

If the "data-source" extension applies to a data node, then a server that implements the "data-source" feature is expected to return the "data-source" XML attribute for that node.

[3.1.](#) Identifying Data Sources

Operational data sources are defined with YANG identity statements. The YANG module in [Section 6](#) contains the base identity "data-sources", and a few common data sources:

- o server: normal case: the server instrumentation is the source of the operational data value.
- o running: the operational data value is derived from a value in the running configuration datastore.
- o operation: the operational data value is derived from a direct or side effect of a client-initiated protocol operation.
- o ntp: the operational data value is derived from NTP information
- o dns: the operational data value is derived from DNS information

Other modules can define new data source identities, such as the "thfp" protocol in the "example-get2" module.

The "data-source" YANG extension is defined in [Section 6](#). It is used within other YANG modules to identify which operational data nodes should have data source information maintained by the server.

Internet-Draft

<get2>

October 2012

4. XSD for the "last-modified" Attribute

The following XML Schema document [[XSD](#)] defines the "last-modified" attribute, described within this document. This XSD is only relevant if the server supports the "timestamps" YANG feature within the "ietf-netconf-get2" YANG module.

The "last-modified" attribute uses the XSD data type "dateTime", in accordance with [Section 3.2.7.1](#) of XML Schema Part 2: Datatypes. This is equivalent to the YANG data type "date-and-time".

<CODE BEGINS> file "last-modified.xsd"

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns="urn:ietf:params:xml:ns:netconf:default:1.0"
  targetNamespace="urn:ietf:params:xml:ns:netconf:last-modified:1.0"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified"
  xml:lang="en">

  <xs:annotation>
    <xs:documentation>
      This schema defines the syntax for the "last-modified" attribute
      described within this document.
    </xs:documentation>
  </xs:annotation>

  <!--
    last-modified attribute
  -->
  <xs:attribute name="last-modified" type="xs:dateTime">
    <xs:annotation>
      <xs:documentation>
        This attribute indicates the date and time when
        a modification was last detected by the server
        for the datastore or data node corresponding to
        the XML element containing this attribute.
      </xs:documentation>
    </xs:annotation>
  </xs:attribute>
</xs:schema>
```

```
</xs:annotation>
</xs:attribute>
</xs:schema>
```

<CODE ENDS>

[5.](#) XSD for the "data-source" Attribute

The following XML Schema document [[XSD](#)] defines the "data-source" attribute, described within this document. This attribute uses the XSD data type "QName", in accordance with [Section 3.2.18.1](#) of XML Schema Part 2: Datatypes.

This is an XML encoding of the YANG "identityref" data type:

- o the module namespace statement value for the YANG module containing the identity statement is represented in the "namespace-name" part.
- o the identity name is represented in the local part.

<CODE BEGINS> file "data-source.xsd"

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns="urn:ietf:params:xml:ns:netconf:default:1.0"
  targetNamespace="urn:ietf:params:xml:ns:netconf:data-source:1.0"
  elementFormDefault="qualified"
  attributeFormDefault="unqualified"
  xml:lang="en">

  <xs:annotation>
    <xs:documentation>
      This schema defines the syntax for the "data-source" attribute
      described within this document.
    </xs:documentation>
  </xs:annotation>
```

```

<!--
  data-source attribute
-->
<xs:attribute name="data-source" type="xs:QName">
  <xs:annotation>
    <xs:documentation>
      This attribute indicates the identity statement
      for the configuration source for the data node
      corresponding to the XML element containing this
      attribute.
    </xs:documentation>
  </xs:annotation>
</xs:attribute>
</xs:schema>

<CODE ENDS>

```

6. data-source YANG Module

RFC Ed.: update the date below with the date of RFC publication and remove this note.

```
<CODE BEGINS> file "ietf-netconf-data-source@2012-10-09.yang"
```

```

module ietf-netconf-data-source {

  namespace "urn:ietf:params:xml:ns:yang:ietf-netconf-data-source";
  prefix datasrc;

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

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

    WG Chair: Mehmet Ersue
               <mailto:mehmet.ersue@nsn.com>

    WG Chair: Bert Wijnen
               <mailto:bertietf@bwijnen.net>

```

Editor: Andy Bierman
<mailto:andy@yumaworks.com>;

description

"This module contains a collection of YANG definitions for identifying the data source of operational data nodes.

Copyright (c) 2012 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 (<http://trustee.ietf.org/license-info>).

This version of this YANG module is part of RFC XXXX; see the RFC itself for full legal notices.";

// RFC Ed.: replace XXXX with actual RFC number and remove this
// note.

Bierman

Expires April 12, 2013

[Page 12]

Internet-Draft

<get2>

October 2012

```
// RFC Ed.: remove this note
// Note: extracted from draft-bierman-netconf-get2-02.txt

// RFC Ed.: update the date below with the date of RFC publication
// and remove this note.
revision "2012-10-09" {
  description
    "Initial revision.";
  reference
    "RFC XXXX: The NETCONF <get2> Operation";
}

/* Extensions */

extension data-source {
  description
    "This extension indicates that the data node containing it
    is expected to support the 'data-source' XML attribute
```

in replies for the <get2> operation.

This extension is ignored if it is not within a YANG data definition statement for an operational data node.";

}

/* Identities */

```
identity data-sources {
  description
    "Base identity for all data sources.";
}
```

```
identity server {
  base data-sources;
  description
    "Indicates the server instrumentation as the data source.";
}
```

```
identity running {
  base data-sources;
  description
    "Indicates the running datastore as the data source.";
}
```

```
identity operation {
  base data-sources;
  description
    "Indicates a client-initiated protocol operation as
    the data source.";
}
```

}

```
identity ntp {
  base data-sources;
  description
    "Indicates the NTP protocol as the data source.";
  reference
    "RFC 5905: Network Time Protocol Version 4:
    Protocol and Algorithms Specification";
}
```

```
identity dns {  
    base data-sources;  
    description  
        "Indicates the DNS protocol as the data source.";  
    // reference TBD  
}  
  
}  
  
<CODE ENDS>
```

[7.](#) <get2> YANG Module

This module imports the "with-defaults-parameters" grouping from [\[RFC6243\]](#).

Several YANG features are imported from [[RFC6241](#)].

Some data types are imported from [[RFC6021](#)].

RFC Ed.: update the date below with the date of RFC publication and remove this note.

<CODE BEGINS> file "ietf-netconf-get2@2012-10-09.yang"

```
module ietf-netconf-get2 {

  namespace "urn:ietf:params:xml:ns:yang:ietf-netconf-get2";
  prefix get2;

  import ietf-inet-types {
    prefix inet;
  }

  import ietf-netconf {
    prefix nc;
  }

  import ietf-netconf-with-defaults {
    prefix ncwd;
  }

  import ietf-yang-types {
    prefix yang;
  }

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

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

     WG Chair: Mehmet Ersue
               <mailto:mehmet.ersue@nsn.com>

     WG Chair: Bert Wijnen
               <mailto:bertietf@bwijnen.net>
```

Editor: Andy Bierman
<mailto:andy@yumaworks.com>;

description

"This module contains a collection of YANG definitions for the retrieval of information from a NETCONF server.

Copyright (c) 2012 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 (<http://trustee.ietf.org/license-info>).

This version of this YANG module is part of RFC XXXX; see the RFC itself for full legal notices.";

// RFC Ed.: replace XXXX with actual RFC number and remove this
// note.

// RFC Ed.: remove this note
// Note: extracted from [draft-bierman-netconf-get2-02.txt](#)

// RFC Ed.: update the date below with the date of RFC publication
// and remove this note.

```
revision "2012-10-09" {  
  description  
    "Initial revision.";  
  reference  
    "RFC XXXX: The NETCONF <get2> Operation";  
}
```

/* Features */

```
feature timestamps {  
  description  
    "This feature indicates that the server implements  
    the <get2> operations parameters which require  
    last modification timestamps to be maintained by  
    the server.
```

If this feature is advertised then one global
'last-modified' timestamp for the entire
running datastore MUST be supported.

Internet-Draft

<get2>

October 2012

```
    The server MAY support additional timestamps
    for additional datastores and data nodes
    within a datastore.  The 'with-timestamps'
    parameter can be used to identify
    which data nodes support a last-modified-time
    timestamp.";
}

feature with-defaults {
  description
    "This feature indicates that the server supports the
    'with-defaults' parameter for the <get2> operation.
    A NETCONF server SHOULD support this feature.";
  reference
    "RFC 6243: With-defaults Capability for NETCONF";
}

feature data-sources {
  description
    "This feature indicates that the server supports the
    'with-data-sources' parameter for the <get2> operation.
    A NETCONF server SHOULD support this feature.";
  reference
    "RFC XXXX: The NETCONF <get2> Operation";
}

/* Protocol Operations */

rpc get2 {
  description
    "Retrieve NETCONF datastore information";
  input {
    container source {
      choice datastore-source {
        default running;
        description
          "The configuration source for the retrieval operation.
          The running configuration is the default choice if
          this parameter is not present.";
        leaf candidate {
```

```

    if-feature nc:candidate;
    type empty;
    description
        "The candidate configuration datastore is the
        retrieval source.";
}
leaf running {
    type empty;

```

```

    description
        "The running configuration datastore is the
        retrieval source.";
}
leaf operational {
    type empty;
    description
        "The collection of non-configuration
        data nodes supported by the server is the
        retrieval source.";
}
leaf startup {
    if-feature nc:startup;
    type empty;
    description
        "The startup configuration datastore is the
        retrieval source.";
}
leaf url {
    if-feature nc:url;
    type inet:uri;
    description
        "The URL-based configuration is the
        retrieval source.";
}
}
}

choice filter-spec {
    anyxml subtree-filter {
        description
            "This parameter identifies the portions of the
            target datastore to retrieve.";
    }
}

```

```

        reference "RFC 6241, Section 6.";
    }
    leaf xpath-filter {
        if-feature nc:xpath;
        type yang:xpath1.0;
        description
            "This parameter contains an XPath expression
             identifying the portions of the target
             datastore to retrieve.";
    }
}

leaf keys-only {
    type empty;
    description

```

```

        "This parameter selects only data nodes which
         are key leaf nodes.  Parent container and
         list nodes are also returned, but no other leafs,
         or any leaf-lists will be included in the reply.";
    }

```

```

leaf if-modified-since {
    if-feature timestamps;
    type yang:date-and-time;
    description
        "This parameter selects only data nodes which
         have been modified since the specified time.";
}

```

```

leaf depth {
    type uint32;
    default 0;
    description
        "This parameter selects how many conceptual
         sub-tree levels should be returned in the
         <rpc-reply>."

```

If this parameter is equal to '0', then entire subtrees will be returned.

If this parameter is greater than '0', then

```

        only the specified number of subtree levels will
        be returned.";
    reference "RFC XXXX, section 2.1.";
}

uses ncwd:with-defaults-parameters {
    if-feature with-defaults;
    description
        "This parameter controls the retrieval of
        default values.";
    reference
        "RFC 6243: With-defaults Capability for NETCONF";
}

leaf with-timestamps {
    if-feature timestamps;
    type empty;
    description
        "This parameter will cause the server to return
        XML attributes identifying the last modification
        time within one or more elements within the
        <rpc-reply>.";
}

```

```

    reference "RFC XXXX, sections 2.2 and 3.";
}

leaf with-data-sources {
    if-feature data-sources;
    when "../source/operational";
    type empty;
    description
        "This parameter will cause the server to return
        XML attributes identifying the operational
        data sources for elements within the
        <rpc-reply> that support the 'data-source'
        YANG extension statement.";
    reference "RFC XXXX, sections 2.2 and 3.";
}

}

output {

```

```

    anyxml data {
      description
        "Copy of the requested datastore subset which
        matched the filter criteria (if any).
        An empty data container indicates that the
        request did not produce any results.";
    }
  }
}
}

<CODE ENDS>

```

8. IANA Considerations

This document registers a URI in the IETF XML registry [[RFC3688](#)]. Following the format in [RFC 3688](#), the following 2 registrations are requested to be made.

URI: urn:ietf:params:xml:ns:yang:ietf-netconf-data-source
 Registrant Contact: The NETCONF WG of the IETF.
 XML: N/A, the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-netconf-get2
 Registrant Contact: The NETCONF WG of the IETF.

XML: N/A, the requested URI is an XML namespace.

This document registers 2 YANG modules in the YANG Module Names registry [[RFC6020](#)].

name: ietf-netconf-data-source
namespace: urn:ietf:params:xml:ns:yang:ietf-netconf-data-source
prefix: cfgsrc
reference: RFC XXXX

name: ietf-netconf-get2
namespace: urn:ietf:params:xml:ns:yang:ietf-netconf-get2
prefix: get2
reference: RFC XXXX

[9.](#) Security Considerations

This document does not introduce any new security concerns in addition to those specified in [\[RFC6241\], section 9](#).

[10.](#) Change Log

-- RFC Ed.: remove this section before publication.

[10.1.](#) 00-01

- o removed subtree-filter YANG feature
- o changed depth filter to exactly match the XML layering
- o renamed filter to subtree-filter
- o renamed select to xpath-filter
- o added some new examples

[10.2.](#) 01-02

- o added operational data source support
- o added 'ietf-netconf-data-source' module
- o clarified terminology

Internet-Draft

<get2>

October 2012

11. References

11.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC6020] Bjorklund, M., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", [RFC 6020](#), October 2010.
- [RFC6021] Schoenwaelder, J., "Common YANG Data Types", [RFC 6021](#), October 2010.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", [RFC 6241](#), June 2011.
- [RFC6243] Bierman, A. and B. Lengyel, "With-defaults Capability for NETCONF", [RFC 6243](#), June 2011.
- [XPath] Clark, J. and S. DeRose, "XML Path Language (XPath) Version 1.0", World Wide Web Consortium Recommendation REC-xpath-19991116, November 1999, <<http://www.w3.org/TR/1999/REC-xpath-19991116>>.
- [XSD] Malhotra, A. and P. Biron, "XML Schema Part 2: Datatypes Second Edition", World Wide Web Consortium Recommendation REC-xmlschema-2-20041028, October 2004, <<http://www.w3.org/TR/2004/REC-xmlschema-2-20041028>>.

11.2. Informative References

- [I-D.ietf-netmod-system-mgmt] Bierman, A. and B. Bjorklund, "YANG Data Model for System Management", [draft-ietf-netmod-system-mgmt-03](#) (work in progress), September 2012.
- [RFC3688] Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#), January 2004.

Internet-Draft

<get2>

October 2012

[Appendix A](#). Examples

[A.1](#). YANG Module Used in Examples

```
module example-get2 {  
  
    namespace "http://example.com/ns/example-get2";  
    prefix exget2;  
  
    import ietf-netconf-data-source { prefix datasrc; }  
  
    revision 2012-10-09;  
  
    identity thfp {  
        base datasrc:data-sources;  
        description  
            "The Tree Height Finder Protocol is  
             the source of the operational data.";  
    }  
  
    identity manual {  
        base datasrc:data-sources;  
        description  
            "The height was derived manually by on-site  
             measurement crews.";  
    }  
  
    container forests {  
        list forest {  
            key name;  
  
            leaf name {  
                type string;  
            }  
        }  
    }  
}
```

```

leaf tree-count {
    config false;
    type uint32;
}

container trees {
    list tree {
        key name;

        leaf name {
            type string;
        }
        leaf location {

```

```

        type string;
    }
    leaf height {
        datasrc:data-source;

        config false;
        type decimal64 {
            fraction-digits 3;
        }
        units meters;
    }
} // list tree
} // container trees
} // list forest
} // container forests
}

```

[A.2.](#) YANG Data Used in Examples

The follow instances are assumed in the following examples.

```

list forest: "north":
    list tree: "birch", "ash", "maple"

list forest: "south":
    list tree: "banyan", "palm"

```

The forests and trees are configured, which represent trees the

company has planted and growing over time.

The operational data (tree height) represents the data that the company monitors for each tree over time.

There are 2 operational data sources for tree height data in this example:

- o thfp: Tree Height Finder Protocol
- o manual: Manual measurement by work crews

The north forest was measured with the mythical Tree Height Finder protocol and the south forest was measured manually.

[A.3.](#) Example: Operational Datastore

This example simply retrieves the "forests" subtree data from the operational datastore.

```
<rpc message-id="101"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <source>
      <operational />
    </source>
    <subtree-filter>
      <forests xmlns="http://example.com/ns/example-get2" />
    </subtree-filter>
  </get2>
</rpc>

<rpc-reply message-id="101"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <forests xmlns="http://example.com/ns/example-get2">
      <forest>
        <name>north</name>
        <tree-count>3</tree-count>
        <trees>
          <tree>
```

```

        <name>birch</name>
        <height>41.013</height>
    </tree>
    <tree>
        <name>ash</name>
        <height>16.523</height>
    </tree>
    <tree>
        <name>maple</name>
        <height>51.204</height>
    </tree>
</trees>
</forest>
<forest>
    <name>south</name>
    <tree-count>2</tree-count>
    <trees>
        <tree>
            <name>banyan</name>
            <height>91.433</height>
        </tree>
        <tree>
            <name>palm</name>
            <height>83.439</height>
        </tree>
    </trees>
</forest>

```

```

    </forests>
</data>
</rpc-reply>

```

[A.4.](#) Example: If-Modified-Since Non-Empty Filter Retrieval

In this example, the running datastore was last modified at "2012-09-09T01:43:27Z" because the forest named "north" was modified at this time.

- o The forest named "north" was last modified after the specified "if-modified-since" timestamp.
- o The forest named "south" was last modified before the specified

"if-modified-since" timestamp.

- o The server maintains a last-modified timestamp for the running datastore and the "forest" list entries.
- o The client is also requesting that timestamps be returned for the nodes that have been modified. If any part of the "forest" subtree is modified then this timestamp will be updated.

```
<rpc message-id="102"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <subtree-filter>
      <forests xmlns="http://example.com/ns/example-get2" />
    </subtree-filter>
    <if-modified-since>2012-09-09T01:43:27Z</if-modified-since>
```



```

    <with-timestamps />
  </get2>
</rpc>

<rpc-reply message-id="102"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns:lm="urn:ietf:params:xml:ns:netconf:last-modified:1.0">
  <data
    xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2"
    lm:last-modified="2012-09-09T02:00:00Z">

    <forests xmlns="http://example.com/ns/example-get2">
      <forest lm:last-modified="2012-09-09T02:00:00Z">
        <name>north</name>
        <trees>
          <tree>
            <name>birch</name>
            <location>hillside</location>
          </tree>
          <tree>
            <name>ash</name>
            <location>southwest pasture</location>
          </tree>
          <tree>
            <name>maple</name>
            <location>east meadow</location>
          </tree>
        </trees>
      </forest>
    </forests>
  </data>
</rpc-reply>

```

[A.5.](#) Example: If-Modified-Since Empty Filter Retrieval

In this example the client has changed the if-modified-since timestamp to a time in the future.

- o No "forest" list entry has been modified since this time so an empty data node is returned.

- o Note that the last-modified timestamp is returned for the node representing the datastore, even though no data nodes have been modified since the specified time. This allows the client to easily retrieve the last-modified timestamp for the entire datastore.

```
<rpc message-id="103"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <subtree-filter>
      <forests xmlns="http://example.com/ns/example-get2" />
    </subtree-filter>
    <if-modified-since>2012-09-09T03:43:27Z</if-modified-since>
    <with-timestamps />
  </get2>
</rpc>
```

```
<rpc-reply message-id="103"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns:lm="urn:ietf:params:xml:ns:netconf:last-modified:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2"
    lm:last-modified="2012-09-09T02:00:00Z" />
</rpc-reply>
```

[A.6.](#) Example: Keys Only Filter Retrieval

This example retrieves the names-only from the "forests" subtree in the running datastore.

- o The default source (running) is used.
- o The default depth="0" is used to retrieve all subtree levels.
- o The xpath-filter is used instead of the subtree-filter
- o Whitespace added to xpath-filter element for display purposes only

Internet-Draft

<get2>

October 2012

```
<rpc message-id="104"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <xpath-filter xmlns:ex=http://example.com/ns/example-get2">
      /ex:forests
    </xpath-filter>
    <keys-only />
  </get2>
</rpc>
```

```
<rpc-reply message-id="104"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <forests xmlns="http://example.com/ns/example-get2">
      <forest>
        <name>north</name>
        <trees>
          <tree>
            <name>birch</name>
          </tree>
          <tree>
            <name>ash</name>
          </tree>
          <tree>
            <name>maple</name>
          </tree>
        </trees>
      </forest>
      <forest>
        <name>south</name>
        <trees>
          <tree>
            <name>banyan</name>
          </tree>
          <tree>
            <name>palm</name>
          </tree>
        </trees>
      </forest>
    </forests>
  </data>
</rpc-reply>
```

[A.7.](#) Example: Testing for Node Existence with Depth=1

This example retrieves the "trees" node to determine which forests have any trees.

- o Only 1 subtree level is requested, instead of the default of all levels.
- o The default source (running) is used.
- o The depth parameter is set to "1" to only retrieve the requested layer (trees) and its ancestor nodes and the configuration leaf nodes from each "forest" entry.

```
<rpc message-id="105"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <subtree-filter>
      <forests xmlns="http://example.com/ns/example-get2">
        <forest>
          <trees />
        </forest>
      </forests>
    </subtree-filter>
    <depth>1</depth>
  </get2>
</rpc>
```

```
<rpc-reply message-id="105"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <forests xmlns="http://example.com/ns/example-get2">
      <forest>
        <name>north</name>
        <trees />
      </forest>
      <forest>
        <name>south</name>
        <trees />
      </forest>
    </forests>
  </data>
</rpc-reply>
```

```
    </forests>
  </data>
</rpc-reply>
```

[A.8.](#) Example: Keys Only Filter Retrieval with Depth=3

This example retrieves the names-only from the "forest" list within the "forests" subtree, in the running datastore.

- o Only 3 subtree levels are requested, instead of the default of all levels.

- o The default source (running) is used.
- o The depth parameter is set to "3" to only retrieve the requested layer (forests), its child nodes (forest), and the key leaf nodes from each "forest" entry. Without the "keys-only" parameter, other leafs from the "forest" list would be returned as well.

```
<rpc message-id="106"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <subtree-filter>
      <forests xmlns="http://example.com/ns/example-get2" />
    </subtree-filter>
    <keys-only />
    <depth>3</depth>
  </get2>
</rpc>
```

```
<rpc-reply message-id="106"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <forests xmlns="http://example.com/ns/example-get2">
      <forest>
        <name>north</name>
      </forest>
      <forest>
        <name>south</name>
      </forest>
    </forests>
  </data>
</rpc-reply>
```

```

    </forests>
  </data>
</rpc-reply>

```

[A.9.](#) Example: Operational Data Sources (tree height)

This example simply retrieves the "forests" subtree data from the operational datastore, but requesting that data-source XML attributes be added as required in the reply.

```

<rpc message-id="107"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <source>
      <operational />
    </source>
    <subtree-filter>
      <forests xmlns="http://example.com/ns/example-get2" />
    </subtree-filter>
  </get2>
</rpc>

```

```

    <with-data-sources />
  </get2>
</rpc>

<rpc-reply message-id="107"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns:ds="urn:ietf:params:xml:ns:netconf:data-source:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <forests xmlns="http://example.com/ns/example-get2"
      xmlns:ex="http://example.com/ns/example-get2">
      <forest>
        <name>north</name>
        <tree-count>3</tree-count>
        <trees>
          <tree>
            <name>birch</name>
            <height ds:data-source="ex:thfp">41.013</height>
          </tree>
          <tree>
            <name>ash</name>
            <height ds:data-source="ex:thfp">16.523</height>
          </tree>
        </trees>
      </forest>
    </forests>
  </data>
</rpc-reply>

```

```

        <tree>
          <name ds:data-source="ex:thfp">maple</name>
          <height>51.204</height>
        </tree>
      </trees>
    </forest>
  <forest>
    <name>south</name>
    <tree-count>2</tree-count>
    <trees>
      <tree>
        <name>banyan</name>
        <height ds:data-source="ex:manual">91.433</height>
      </tree>
      <tree>
        <name>palm</name>
        <height ds:data-source="ex:manual">83.439</height>
      </tree>
    </trees>
  </forest>
</forests>
</data>
</rpc-reply>

```

[A.10.](#) Example: Operational Data Sources (ietf-system)

This example shows how the data-source reporting can be used with a real YANG module. The `ietf-system` module defined in [\[I-D.ietf-netmod-system-mgmt\]](#) contains an operational data node called "current-datetime". The data source for this node can either be NTP or the "set-current-datetime" operation defined in the module.

To implement data source reporting, the "data-source" extension needs to be added to the "current-datetime" leaf as follows:

```

leaf current-datetime {
  datasrc:data-source;
  type yang:date-and-time;
  config false;
}

```

```
    description
      "The current system date and time.";
  }
```

The following example shows the retrieval of the "current-datetime" leaf if the data source is NTP. The extra whitespace shown for the "current-datetime" leaf is for display purposes only.

```
<rpc message-id="108"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <source>
      <operational />
    </source>
    <subtree-filter>
      <system xmlns="urn:ietf:params:xml:ns:yang:ietf-system">
```



```

        <clock>
          <current-datetime />
        </clock>
      </system>
    </subtree-filter>
    <with-data-sources />
  </get2>
</rpc>

<rpc-reply message-id="108"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns:ds="urn:ietf:params:xml:ns:netconf:data-source:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <system xmlns="urn:ietf:params:xml:ns:yang:ietf-system">
      <clock>
        <current-datetime ds:data-source="ds:ntp">
          2012-09-09T01:11:27Z
        </current-datetime>
      </clock>
    </system>
  </data>
</rpc-reply>

```

The following example shows the retrieval of the "current-datetime" leaf if the data source is the "set-current-datetime" operation. The extra whitespace shown for the "current-datetime" leaf is for display purposes only.

```

<rpc message-id="109"

```

```

xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<get2 xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
  <source>
    <operational />
  </source>
  <subtree-filter>
    <system xmlns="urn:ietf:params:xml:ns:yang:ietf-system">
      <clock>
        <current-datetime />
      </clock>
    </system>
  </subtree-filter>
  <with-data-sources />
</get2>
</rpc>

<rpc-reply message-id="109"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns:ds="urn:ietf:params:xml:ns:netconf:data-source:1.0">
  <data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-get2">
    <system xmlns="urn:ietf:params:xml:ns:yang:ietf-system">
      <clock>
        <current-datetime ds:data-source="ds:operation">
          2012-09-09T01:11:27Z
        </current-datetime>
      </clock>
    </system>
  </data>
</rpc-reply>

```

Internet-Draft

<get2>

October 2012

Author's Address

Andy Bierman
YumaWorks

Email: andy@yumaworks.com

