

Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: February 16, 2017

A. Bierman
YumaWorks
M. Bjorklund
Tail-f Systems
K. Watsen
Juniper Networks
August 15, 2016

YANG Patch Media Type
draft-ietf-netconf-yang-patch-11

Abstract

This document describes a method for applying patches to configuration datastores using data defined with the YANG data modeling language.

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 February 16, 2017.

Copyright Notice

Copyright (c) 2016 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.

Table of Contents

1.	Introduction	3
1.1.	Terminology	3
1.1.1.	NETCONF	3
1.1.2.	HTTP	4
1.1.3.	YANG	4
1.1.4.	RESTCONF	4
1.1.5.	YANG Patch	5
1.1.6.	Examples	5
1.1.7.	Tree Diagrams	6
2.	YANG Patch	6
2.1.	Target Resource	7
2.2.	yang-patch Input	7
2.3.	yang-patch-status Output	8
2.4.	Target Data Node	9
2.5.	Edit Operations	10
2.6.	Successful Edit Response Handling	10
2.7.	Error Handling	10
2.8.	yang-patch RESTCONF Capability	11
3.	YANG Module	11
4.	IANA Considerations	20
4.1.	YANG Module Registry	20
4.2.	Media Types	20
4.2.1.	Media Type application/yang-patch+xml	20
4.2.2.	Media Type application/yang-patch+json	22
4.3.	RESTCONF Capability URNs	24
5.	Security Considerations	24
6.	Normative References	24
Appendix A.	Acknowledgements	26
Appendix B.	Change Log	26
B.1.	v10 to v11	26
B.2.	v09 to v10	26
B.3.	v08 to v09	27
B.4.	v07 to v08	27
B.5.	v06 to v07	27
B.6.	v05 to v06	28
B.7.	v04 to v05	28
B.8.	v03 to v04	28
B.9.	v02 to v03	28
B.10.	v01 to v02	29
B.11.	v00 to v01	29
B.12.	bierman:yang-patch-00 to ietf:yang-patch-00	30
Appendix C.	Open Issues	30
Appendix D.	Example YANG Module	30

D.1.	YANG Patch Examples	31
D.1.1.	Add Resources: Error	31
D.1.2.	Add Resources: Success	34
D.1.3.	Insert list entry example	36
D.1.4.	Move list entry example	38
D.1.5.	Edit datastore resource example	39
	Authors' Addresses	41

[1.](#) Introduction

There is a need for standard mechanisms to patch datastores defined in [\[RFC6241\]](#), which contain conceptual data that conforms to schema specified with YANG [\[I-D.ietf-netmod-rfc6020bis\]](#). An "ordered edit list" approach is needed to provide RESTCONF client developers with more precise RESTCONF client control of the edit procedure than existing mechanisms found in [\[I-D.ietf-netconf-restconf\]](#).

This document defines a media type for a YANG-based editing mechanism that can be used with the HTTP PATCH method [\[RFC5789\]](#). YANG Patch is designed to support the RESTCONF protocol, defined in [\[I-D.ietf-netconf-restconf\]](#).

It may be possible to use YANG Patch with other protocols besides RESTCONF. This is outside the scope of this document. It may be possible to use YANG Patch with datastore types other than a configuration datastore. This is outside the scope of this document.

[1.1.](#) 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](#), [\[RFC2119\]](#).

[1.1.1.](#) NETCONF

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

- o configuration data
- o datastore
- o configuration datastore
- o protocol operation
- o running configuration datastore

- o state data
- o user

1.1.2. HTTP

The following terms are defined in [[RFC7230](#)]:

- o header field
- o message-body
- o query
- o request URI

The following terms are defined in [[RFC7231](#)]:

- o method
- o request
- o resource

1.1.3. YANG

The following terms are defined in [[I-D.ietf-netmod-rfc6020bis](#)]:

- o container
- o data node
- o leaf
- o leaf-list
- o list
- o RPC operation (now called protocol operation)

1.1.4. RESTCONF

The following terms are defined in [[I-D.ietf-netconf-restconf](#)]:

- o application/yang-data
- o application/yang-data+json

- o data resource
- o datastore resource
- o patch
- o RESTCONF capability
- o target resource
- o YANG data template

1.1.5. YANG Patch

The following terms are used within this document:

- o RESTCONF client: a client which implements the RESTCONF protocol.
- o RESTCONF server: a server which implements the RESTCONF protocol.
- o YANG Patch: a conceptual edit request using the "yang-patch" YANG Patch template, defined in [Section 3](#). In HTTP, refers to a PATCH method where a representation uses either the media type "application/yang-patch-xml" or "application/yang-patch+json".
- o YANG Patch Status: a conceptual edit status response using the YANG "yang-patch-status" YANG data template, defined in [Section 3](#). In HTTP, refers to a response message for a PATCH method, where it has a representation with either the media type "application/yang-data" or "application/yang-data+json".
- o YANG Patch template: this is similar to a YANG data template, except it has a representation with the media type "application/yang-patch-xml" or "application/yang-patch+json".

1.1.6. Examples

Some protocol message lines within examples throughout the document are split into multiple lines for display purposes only. When a line ends with backslash ('\') as the last character, the line is wrapped for display purposes. It is to be considered to be joined to the next line by deleting the backslash, the following line break, and the leading whitespace of the next line.

1.1.7. Tree Diagrams

A simplified graphical representation of the data model is used in this document. The meaning of the symbols in these diagrams is as follows:

- o Brackets "[" and "]" enclose list keys.
- o Abbreviations before data node names: "rw" means configuration data (read-write), "ro" state data (read-only), and "x" operation resource (executable)
- o Symbols after data node names: "?" means an optional node and "*" denotes a "list" and "leaf-list".
- o Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").
- o Ellipsis ("...") stands for contents of subtrees that are not shown.

2. YANG Patch

A "YANG Patch" is an ordered list of edits that are applied to the target datastore by the RESTCONF server. The specific fields are defined in the YANG module in [Section 3](#).

The YANG Patch operation is invoked by the RESTCONF client by sending a PATCH method request with a representation using either the "application/yang-patch+xml" or "application/yang-patch+json" media type. A message-body representing the YANG Patch input parameters MUST be provided.

YANG Patch has some features that are not possible with the PATCH method in RESTCONF:

- o YANG Patch allows multiple sub-resources to be edited at within the same PATCH method.
- o YANG Patch allows more precise edit operations than RESTCONF. There are 7 operations supported (create, delete, insert, merge, move, replace, remove).
- o YANG Patch uses an edit list with an explicit processing order. The edits are processed in client-specified order, and error processing can be precise even when multiple errors occur in the same patch request.

The YANG Patch "patch-id" may be useful for debugging, and SHOULD be present in any audit logging records generated by the RESTCONF server for a patch.

The RESTCONF server MUST return the Accept-Patch header field in an OPTIONS response, as specified in [RFC5789], which includes the media type for YANG Patch.

Note that YANG Patch can only edit data resources. The PATCH method cannot be used to replace the datastore resource. Although the "ietf-yang-patch" YANG module is written using YANG 1.1 [I-D.ietf-netmod-rfc6020bis], an implementation of YANG Patch can be used with content defined in YANG 1.0 [RFC6020] as well.

Example:

Accept-Patch: application/yang-patch+xml,application/yang-patch+json

A YANG Patch can be encoded in XML format according to [W3C.REC-xml-20081126]. It can also be encoded in JSON, according to "JSON Encoding of Data Modeled with YANG" [I-D.ietf-netmod-yang-json]. If any meta-data needs to be sent in a JSON message, it is encoded according to "Defining and Using Metadata with YANG" [I-D.ietf-netmod-yang-metadata].

2.1. Target Resource

The YANG Patch operation uses the RESTCONF target resource URI to identify the resource that will be patched. This can be the datastore resource itself, i.e., "{+restconf}/data", to edit top-level configuration data resources, or it can be a configuration data resource within the datastore resource, e.g., "{+restconf}/data/ietf-interfaces:interfaces", to edit sub-resources within a top-level configuration data resource.

Each edit with a YANG Patch identifies a target data node for the associated edit. This is described in [Section 2.4](#).

2.2. yang-patch Input

A YANG patch is optionally identified by a unique "patch-id" and it may have an optional comment. A patch is an ordered collection of edits. Each edit is identified by an "edit-id" and it has an edit operation (create, delete, insert, merge, move, replace, remove) that is applied to the target resource. Each edit can be applied to a sub-resource "target" within the target resource. If the operation is "insert" or "move", then the "where" parameter indicates how the

node is inserted or moved. For values "before" and "after", the "point" parameter specifies the data node insertion point.

A message-body representing the YANG Patch is sent by the RESTCONF client to specify the edit operation request. When used with the HTTP PATCH method, this data is identified by the YANG Patch media type.

YANG tree diagram for "yang-patch" Container

```
+---- yang-patch
  +---- patch-id?   string
  +---- comment?    string
  +---- edit* [edit-id]
    +---- edit-id?   string
    +---- operation   enumeration
    +---- target      target-resource-offset
    +---- point?      target-resource-offset
    +---- where?      enumeration
    +---- value?
```

2.3. yang-patch-status Output

A message-body representing the YANG Patch Status is returned to the RESTCONF client to report the detailed status of the edit operation. When used with the HTTP PATCH method, this data is identified by the YANG Patch Status media type, and the syntax specification is defined in [Section 3](#).

YANG tree diagram for "yang-patch-status" Container:


```

+---- yang-patch-status
+---- patch-id?      string
+---- (global-status)?
| +--:(global-errors)
| | +---- errors
| |   +---- error*
| |     +---- error-type      enumeration
| |     +---- error-tag       string
| |     +---- error-app-tag?  string
| |     +---- error-path?     instance-identifier
| |     +---- error-message?  string
| |     +---- error-info?
| +--:(ok)
|   +---- ok?              empty
+---- edit-status
+---- edit* [edit-id]
+---- edit-id?  string
+---- (edit-status-choice)?
+--:(ok)
| +---- ok?      empty
+--:(errors)
+---- errors
+---- error*
+---- error-type      enumeration
+---- error-tag       string
+---- error-app-tag?  string
+---- error-path?     instance-identifier
+---- error-message?  string
+---- error-info?

```

2.4. Target Data Node

The target data node for each edit operation is determined by the value of the target resource in the request and the "target" leaf within each "edit" entry.

If the target resource specified in the request URI identifies a datastore resource, then the path string in the "target" leaf is treated as an absolute path expression identifying the target data node for the corresponding edit. The first node specified in the "target" leaf is a top-level data node defined within a YANG module. The "target" leaf MUST NOT contain a single forward slash "/", since this would identify the datastore resource, not a data resource.

If the target resource specified in the request URI identifies a configuration data resource, then the path string in the "target" leaf is treated as a relative path expression. The first node specified in the "target" leaf is a child configuration data node of

the data node associated with the target resource. If the "target" leaf contains a single forward slash "/", then the target data node is the target resource data node.

2.5. Edit Operations

Each YANG patch edit specifies one edit operation on the target data node. The set of operations is aligned with the NETCONF edit operations, but also includes some new operations.

Operation	Description
create	create a new data resource if it does not already exist or error
delete	delete a data resource if it already exists or error
insert	insert a new user-ordered data resource
merge	merge the edit value with the target data resource; create if it does not already exist
move	re-order the target data resource
replace	replace the target data resource with the edit value
remove	remove a data resource if it already exists

YANG Patch Edit Operations

2.6. Successful Edit Response Handling

If a YANG Patch is completed without errors, the RESTCONF server SHOULD return a "yang-patch-status" message.

The RESTCONF server will save the running datastore to non-volatile storage if it supports non-volatile storage, and if the running datastore contents have changed, as specified in [\[I-D.ietf-netconf-restconf\]](#).

Refer to [Appendix D.1.2](#) for a example of a successful YANG Patch response.

2.7. Error Handling

If a well-formed, schema-valid YANG Patch message is received, then the RESTCONF server will process the supplied edits in ascending order. The following error modes apply to the processing of this edit list:

If a YANG Patch is completed with errors, the RESTCONF server SHOULD return a "yang-patch-status" message.

Refer to [Appendix D.1.1](#) for a example of an error YANG Patch response.

2.8. yang-patch RESTCONF Capability

A URI is defined to identify the YANG Patch extension to the base RESTCONF protocol. If the RESTCONF server supports the YANG Patch media type, then the "yang-patch" RESTCONF capability defined in [Section 4.3](#) MUST be present in the "capability" leaf-list in the "ietf-restconf-monitoring" module defined in [\[I-D.ietf-netconf-restconf\]](#).

3. YANG Module

The "ietf-yang-patch" module defines conceptual definitions with the 'yang-data' extension statements, which are not meant to be implemented as datastore contents by a RESTCONF server.

The "ietf-restconf" module from [\[I-D.ietf-netconf-restconf\]](#) is used by this module for the 'yang-data' extension definition.

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

<CODE BEGINS> file "ietf-yang-patch@2016-08-15.yang"

```
module ietf-yang-patch {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-yang-patch";
  prefix "ypatch";

  import ietf-restconf { prefix rc; }

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

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

    Author:   Andy Bierman
              <mailto:andy@yumaworks.com>

    Author:   Martin Bjorklund
              <mailto:mbj@tail-f.com>

    Author:   Kent Watsen
              <mailto:kwatsen@juniper.net>;
```


description

"This module contains conceptual YANG specifications for the YANG Patch and YANG Patch Status data structures.

Note that the YANG definitions within this module do not represent configuration data of any kind.

The YANG grouping statements provide a normative syntax for XML and JSON message encoding purposes.

Copyright (c) 2016 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-ietf-netconf-yang-patch-11.txt](#)

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

```
revision 2016-08-15 {  
  description  
    "Initial revision."  
  reference  
    "RFC XXXX: YANG Patch Media Type."  
}
```

```
typedef target-resource-offset {  
  type string;  
  description  
    "Contains a data resource identifier string representing  
    a sub-resource within the target resource.  
    The document root for this expression is the  
    target resource that is specified in the  
    protocol operation (e.g., the URI for the PATCH request).
```

```
    This string is encoded according the same rules as  
    a data resource identifier in a RESTCONF Request URI.";
```



```
// RFC Ed.: replace "draft-ietf-netconf-restconf" below
// with RFC XXXX, where XXXX is the number of the RESTCONF RFC,
// and remove this note.

reference
  "draft-ietf-netconf-restconf, section 3.5.3";
}

rc:yang-data "yang-patch" {
  uses yang-patch;
}

rc:yang-data "yang-patch-status" {
  uses yang-patch-status;
}

grouping yang-patch {

  description
    "A grouping that contains a YANG container
    representing the syntax and semantics of a
    YANG Patch edit request message.";

  container yang-patch {
    description
      "Represents a conceptual sequence of datastore edits,
      called a patch. Each patch is given a client-assigned
      patch identifier. Each edit MUST be applied
      in ascending order, and all edits MUST be applied.
      If any errors occur, then the target datastore MUST NOT
      be changed by the patch operation.

      YANG datastore validation is performed before any edits
      have been applied to the running datastore.

      It is possible for a datastore constraint violation to occur
      due to any node in the datastore, including nodes not
      included in the edit list. Any validation errors MUST
      be reported in the reply message.";

    reference
      "draft-ietf-netmod-rfc6020bis, section 8.3";

    leaf patch-id {
      type string;
      description
        "An arbitrary string provided by the client to identify
        the entire patch. Error messages returned by the server
```



```
    pertaining to this patch will be identified by this
    patch-id value.";
}

leaf comment {
    type string;
    description
        "An arbitrary string provided by the client to describe
        the entire patch. This value SHOULD be present in any
        audit logging records generated by the server for the
        patch.";
}

list edit {
    key edit-id;
    ordered-by user;

    description
        "Represents one edit within the YANG Patch
        request message. The edit list is applied
        in the following manner:

        - The first edit is conceptually applied to a copy
          of the existing target datastore, e.g., the
          running configuration datastore.
        - Each ascending edit is conceptually applied to
          the result of the previous edit(s).
        - After all edits have been successfully processed,
          the result is validated according to YANG constraints.
        - If successful, the server will attempt to apply
          the result to the target datastore. ";

    leaf edit-id {
        type string;
        description
            "Arbitrary string index for the edit.
            Error messages returned by the server pertaining
            to a specific edit will be identified by this
            value.";
    }

    leaf operation {
        type enumeration {
            enum create {
                description
                    "The target data node is created using the
                    supplied value, only if it does not already
                    exist.get' leaf identifies the data node to be
```



```
        created, not the parent data node.";
    }
    enum delete {
        description
            "Delete the target node, only if the data resource
            currently exists, otherwise return an error.";
    }
    enum insert {
        description
            "Insert the supplied value into a user-ordered
            list or leaf-list entry. The target node must
            represent a new data resource. If the 'where'
            parameter is set to 'before' or 'after', then
            the 'point' parameter identifies the insertion
            point for the target node.";
    }
    enum merge {
        description
            "The supplied value is merged with the target data
            node.";
    }
    enum move {
        description
            "Move the target node. Reorder a user-ordered
            list or leaf-list. The target node must represent
            an existing data resource. If the 'where' parameter
            is set to 'before' or 'after', then the 'point'
            parameter identifies the insertion point to move
            the target node.";
    }
    enum replace {
        description
            "The supplied value is used to replace the target
            data node.";
    }
    enum remove {
        description
            "Delete the target node if it currently exists.";
    }
}
mandatory true;
description
    "The datastore operation requested for the associated
    edit entry";
}

leaf target {
    type target-resource-offset;
```



```
    mandatory true;
    description
      "Identifies the target data node for the edit
       operation. If the target has the value '/', then
       the target data node is the target resource.
       The target node MUST identify a data resource,
       not the datastore resource.";
  }

  leaf point {
    when "(../operation = 'insert' or ../operation = 'move') "
      + "and (../where = 'before' or ../where = 'after')" {
      description
        "Point leaf only applies for insert or move
         operations, before or after an existing entry.";
    }
    type target-resource-offset;
    description
      "The absolute URL path for the data node that is being
       used as the insertion point or move point for the
       target of this edit entry.";
  }

  leaf where {
    when "../operation = 'insert' or ../operation = 'move'" {
      description
        "Where leaf only applies for insert or move
         operations.";
    }
    type enumeration {
      enum before {
        description
          "Insert or move a data node before the data resource
           identified by the 'point' parameter.";
      }
      enum after {
        description
          "Insert or move a data node after the data resource
           identified by the 'point' parameter.";
      }
      enum first {
        description
          "Insert or move a data node so it becomes ordered
           as the first entry.";
      }
      enum last {
        description
          "Insert or move a data node so it becomes ordered
```



```

        as the last entry.";
    }
}
default last;
description
    "Identifies where a data resource will be inserted or
    moved. YANG only allows these operations for
    list and leaf-list data nodes that are ordered-by
    user.";
}

anydata value {
    when "../operation = 'create' "
        + "or ../operation = 'merge' "
        + "or ../operation = 'replace' "
        + "or ../operation = 'insert'" {
        description
            "Value node only used for create, merge,
            replace, and insert operations";
    }
    description
        "Value used for this edit operation. The anydata 'value'
        contains the target resource associated with the
        'target' leaf.

```

For example, suppose the target node is a YANG container named foo:

```

    container foo {
        leaf a { type string; }
        leaf b { type int32; }
    }

```

The 'value' node contains one instance of foo:

```

    <value>
        <foo xmlns='example-foo-namespace'>
            <a>some value</a>
            <b>42</b>
        </foo>
    </value>
    ";
}
}
}

} // grouping yang-patch

```



```
grouping yang-patch-status {

  description
    "A grouping that contains a YANG container
    representing the syntax and semantics of
    YANG Patch status response message.";

  container yang-patch-status {
    description
      "A container representing the response message
      sent by the server after a YANG Patch edit
      request message has been processed.";

    leaf patch-id {
      type string;
      description
        "The patch-id value used in the request.
        If there was no patch-id present in the request
        then this field will not be present.";
    }

    choice global-status {
      description
        "Report global errors or complete success.
        If there is no case selected then errors
        are reported in the edit-status container.";

      case global-errors {
        uses rc:errors;
        description
          "This container will be present if global
          errors that are unrelated to a specific edit
          occurred.";
      }

      leaf ok {
        type empty;
        description
          "This leaf will be present if the request succeeded
          and there are no errors reported in the edit-status
          container.";
      }
    }
  }

  container edit-status {
    description
      "This container will be present if there are
      edit-specific status responses to report.
      If all edits succeeded and the 'global-status'
```



```
        returned is 'ok', then a server MAY omit this
        container";

list edit {
    key edit-id;

    description
        "Represents a list of status responses,
        corresponding to edits in the YANG Patch
        request message. If an edit entry was
        skipped or not reached by the server,
        then this list will not contain a corresponding
        entry for that edit.";

    leaf edit-id {
        type string;
        description
            "Response status is for the edit list entry
            with this edit-id value.";
    }
    choice edit-status-choice {
        description
            "A choice between different types of status
            responses for each edit entry.";
        leaf ok {
            type empty;
            description
                "This edit entry was invoked without any
                errors detected by the server associated
                with this edit.";
        }
        case errors {
            uses rc:errors;
            description
                "The server detected errors associated with the
                edit identified by the same edit-id value.";
        }
    }
}

} // grouping yang-patch-status

}
```

<CODE ENDS>

4. IANA Considerations

4.1. YANG Module Registry

This document registers one URI as a namespace in the IETF XML registry [[RFC3688](#)]. Following the format in [RFC 3688](#), the following registration is requested to be made.

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

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

```
name:          ietf-yang-patch
namespace:     urn:ietf:params:xml:ns:yang:ietf-yang-patch
prefix:        ypatch
// RFC Ed.: replace XXXX with RFC number and remove this note
reference:     RFC XXXX
```

4.2. Media Types

4.2.1. Media Type application/yang-patch-xml

Type name: application

Subtype name: yang-patch

Required parameters: None

Optional parameters: None

```
// RFC Ed.: replace draft-ietf-netmod-rfc6020bis with
// the actual RFC reference for YANG 1.1, and remove this note.
```

```
// RFC Ed.: replace 'XXXX' with the real RFC number,
// and remove this note
```

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 [[draft-ietf-netmod-rfc6020bis](#)]. In addition, the "yang-patch" YANG Patch template found in [RFCXXXX] defines the structure of a YANG Patch request.

```
// RFC Ed.: replace 'NN' in Section NN of [RFCXXXX] with the
// section number for Security Considerations
```


// Replace 'XXXX' in Section NN of [RFCXXXX] with the actual
// RFC number, and remove this note.

Security considerations: Security considerations related
to the generation and consumption of RESTCONF messages
are discussed in Section NN of [RFCXXXX].
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.

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

Interoperability considerations: [RFCXXXX] specifies the format
of conforming messages and the interpretation thereof.

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

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: The fragment field in the
request URI has no defined purpose.

Additional information:

Deprecated alias names for this type: N/A
Magic number(s): N/A
File extension(s): .xml
Macintosh file type code(s): "TEXT"

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

Person & email address to contact for further information: See
Authors' Addresses section of [RFCXXXX].

Intended usage: COMMON

Restrictions on usage: N/A

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

Author: See Authors' Addresses section of [RFCXXXX].

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

Provisional registration? (standards tree only): no

4.2.2. Media Type application/yang-patch+json

Type name: application

Subtype name: yang-patch+json

Required parameters: None

Optional parameters: None

// RFC Ed.: replace [draft-ietf-netmod-yang-json](#) with
// the actual RFC reference for JSON Encoding of YANG Data,
// and remove this note.

// RFC Ed.: replace [draft-ietf-netmod-yang-metadata](#) with
// the actual RFC reference for JSON Encoding of YANG Data,
// and remove this note.

// RFC Ed.: replace 'XXXX' with the real RFC number,
// and remove this note

Encoding considerations: 8-bit

Each conceptual YANG data node is encoded according to
[\[draft-ietf-netmod-yang-json\]](#). A data annotation is
encoded according to [\[draft-ietf-netmod-yang-metadata\]](#)
In addition, the "yang-patch" YANG Patch template found
in [RFCXXXX] defines the structure of a YANG Patch request.

// RFC Ed.: replace 'NN' in Section NN of [RFCXXXX] with the
// section number for Security Considerations
// Replace 'XXXX' in Section NN of [RFCXXXX] with the actual
// RFC number, and remove this note.

Security considerations: Security considerations related
to the generation and consumption of RESTCONF messages
are discussed in Section NN of [RFCXXXX].
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.

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

Interoperability considerations: [RFCXXXX] specifies the format
of conforming messages and the interpretation thereof.

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

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: The syntax and semantics
of fragment identifiers are the same as specified for the
"application/json" media type.

Additional information:

Deprecated alias names for this type: N/A
Magic number(s): N/A
File extension(s): .json
Macintosh file type code(s): "TEXT"

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

Person & email address to contact for further information: See
Authors' Addresses section of [RFCXXXX].

Intended usage: COMMON

Restrictions on usage: N/A

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

Author: See Authors' Addresses section of [RFCXXXX].

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

Provisional registration? (standards tree only): no

4.3. RESTCONF Capability URNs

This document registers one capability identifier in "RESTCONF Protocol Capability URNs" registry

Index

Capability Identifier

:yang-patch

urn:ietf:params:restconf:capability:yang-patch:1.0

5. Security Considerations

The YANG Patch media type does not introduce any significant new security threats, beyond what is described in [\[I-D.ietf-netconf-restconf\]](#). This document defines edit processing instructions for a variant of the PATCH method, as used within the RESTCONF protocol.

It may be possible to use YANG Patch with other protocols besides RESTCONF, which is outside the scope of this document.

It is important for RESTCONF server implementations to carefully validate all the edit request parameters in some manner. If the entire YANG Patch request cannot be completed, then no configuration changes to the system are done. A PATCH request MUST be applied atomically, as specified in [section 2 of \[RFC5789\]](#).

A RESTCONF server implementation SHOULD attempt to prevent system disruption due to partial processing of the YANG Patch edit list. It may be possible to construct an attack on such a RESTCONF server, which relies on the edit processing order mandated by YANG Patch.

A RESTCONF server implementation SHOULD attempt to prevent system disruption due to excessive resource consumption required to fulfill YANG Patch edit requests. It may be possible to construct an attack on such a RESTCONF server, which attempts to consume all available memory or other resource types.

6. Normative References

[I-D.ietf-netconf-restconf]

Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", [draft-ietf-netconf-restconf-13](#) (work in progress), April 2016.

- [I-D.ietf-netmod-rfc6020bis]
Bjorklund, M., "The YANG 1.1 Data Modeling Language",
[draft-ietf-netmod-rfc6020bis-11](#) (work in progress),
February 2016.
- [I-D.ietf-netmod-yang-json]
Lhotka, L., "JSON Encoding of Data Modeled with YANG",
[draft-ietf-netmod-yang-json-10](#) (work in progress), March
2016.
- [I-D.ietf-netmod-yang-metadata]
Lhotka, L., "Defining and Using Metadata with YANG",
[draft-ietf-netmod-yang-metadata-07](#) (work in progress),
March 2016.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate
Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC3688] Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#),
DOI 10.17487/RFC3688, January 2004,
<<http://www.rfc-editor.org/info/rfc3688>>.
- [RFC5789] Dusseault, L. and J. Snell, "PATCH Method for HTTP",
[RFC 5789](#), March 2010.
- [RFC6020] Bjorklund, M., "YANG - A Data Modeling Language for the
Network Configuration Protocol (NETCONF)", [RFC 6020](#),
October 2010.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed.,
and A. Bierman, Ed., "Network Configuration Protocol
(NETCONF)", [RFC 6241](#), June 2011.
- [RFC7159] Bray, T., Ed., "The JavaScript Object Notation (JSON) Data
Interchange Format", [RFC 7159](#), DOI 10.17487/RFC7159, March
2014, <<http://www.rfc-editor.org/info/rfc7159>>.
- [RFC7230] Fielding, R., Ed. and J. Reschke, Ed., "Hypertext Transfer
Protocol (HTTP/1.1): Message Syntax and Routing",
[RFC 7230](#), DOI 10.17487/RFC7230, June 2014,
<<http://www.rfc-editor.org/info/rfc7230>>.
- [RFC7231] Fielding, R. and J. Reschke, "Hypertext Transfer Protocol
(HTTP/1.1): Semantics and Content", [RFC 7231](#), June 2014.

[W3C.REC-xml-20081126]

Yergeau, F., Maler, E., Paoli, J., Sperberg-McQueen, C., and T. Bray, "Extensible Markup Language (XML) 1.0 (Fifth Edition)", World Wide Web Consortium Recommendation REC-xml-20081126, November 2008, <<http://www.w3.org/TR/2008/REC-xml-20081126>>.

Appendix A. Acknowledgements

The authors would like to thank the following people for their contributions to this document: Rex Fernando.

Contributions to this material by Andy Bierman are based upon work supported by the The Space & Terrestrial Communications Directorate (S&TCD) under Contract No. W15P7T-13-C-A616. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of The Space & Terrestrial Communications Directorate (S&TCD).

Appendix B. Change Log

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

The YANG Patch issue tracker can be found here: <https://github.com/netconf-wg/yang-patch/issues>

B.1. v10 to v11

- o change application/yang-patch to application/yang-patch+xml
- o change server to RESTCONF server and remove NETCONF server term
- o change client to RESTCONF client and remove NETCONF client term
- o clarified that YANG 1.0 content can be used in a YANG Patch implementation
- o clarified more terminology
- o fixed missing keys in edit exmaples
- o added insert list example

B.2. v09 to v10

- o change yang-patch+xml to yang-patch
- o clarify application/yang-patch+json media type

- o add edit datastore example
- o change data-resource-offset typedef so it is consistent for XML and JSON

B.3. v08 to v09

- o change [RFC 7158](#) reference to [RFC 7159](#) reference
- o change [RFC 2616](#) reference to [RFC 7230](#) reference
- o remove unused HTTP terms
- o remove import-by-revision of ietf-restconf; not needed
- o change application/yang.patch media type to application/yang-patch
- o remove application/yang.patch-status media type; use application/yang-data instead

B.4. v07 to v08

- o clarified target datastore and target data node terms
- o clarified that target leaf can be single forward slash '/'
- o added Successful edit response handling section
- o clarified that YANG Patch draft is for RESTCONF protocol only but may be defined for other protocols outside this document
- o clarified that YANG Patch draft is for configuration datastores only but may be defined for other datastore types outside this document
- o fixed typos

B.5. v06 to v07

- o converted YANG module to YANG 1.1
- o changed anyxml value to anydata value
- o updated import revision date for ietf-restconf
- o updated revision date for ietf-yang-patch because import-by-revision date needed to be changed

B.6. v05 to v06

- o changed errors example so a full request and error response is shown in XML format
- o fixed error-path to match instance-identifier encoding for both XML and JSON
- o added references for YANG to JSON and YANG Metadata drafts
- o clarified that YANG JSON drafts are used for encoding, not plain JSON

B.7. v04 to v05

- o updated reference to RESTCONF

B.8. v03 to v04

- o removed NETCONF specific text
- o changed data-resource-offset typedef from a relative URI to an XPath absolute path expression
- o clarified insert operation
- o removed requirement that edits MUST be applied in ascending order
- o change SHOULD keep datastore unchanged on error to MUST (this is required by HTTP PATCH)
- o removed length restriction on 'comment' leaf
- o updated YANG tree for example-jukebox library

B.9. v02 to v03

- o added usage of restconf-media-type extension to map the yang-patch and yang-patch-status groupings to media types
- o added yang-patch RESTCONF capability URI
- o Added sub-section for terms used from RESTCONF
- o filled in security considerations section

B.10. v01 to v02

- o Reversed order of change log
- o Clarified anyxml structure of "value" parameter within a YANG patch request (github issue #1)
- o Updated RESTCONF reference
- o Added note to open issues section to check github instead

B.11. v00 to v01

- o Added text requiring support for Accept-Patch header field, and removed 'Identification of YANG Patch capabilities' open issue.
- o Removed 'location' leaf from yang-patch-status grouping
- o Removed open issue 'Protocol independence' because the location leaf was removed.
- o Removed open issue 'RESTCONF coupling' because there is no concern about a normative reference to RESTCONF. There may need to be a YANG 1.1 mechanism to allow protocol template usage (instead of grouping wrapper).
- o Removed open issue 'Is the delete operation needed'. It was decided that both delete and remove should remain as operations and clients can choose which one to use. This is not an implementation burden on the server.
- o Removed open issue 'global-errors needed'. It was decided that they are needed as defined because the global <ok/> is needed and the special key value for edit=global error only allows for 1 global error.
- o Removed open issue 'Is location leaf needed'. It was decided that it is not needed so this leaf has been removed.
- o Removed open issue 'Bulk editing support in yang-patch-status'. The 'location' leaf has been removed so this issue is no longer applicable.
- o Removed open issue 'Edit list mechanism'. Added text to the 'edit' list description-stmt about how the individual edits must be processed. There is no concern about duplicate edits which cause intermediate results to be altered by subsequent edits in the same edit list.

B.12. bierman:yang-patch-00 to ietf:yang-patch-00

- o Created open issues section

Appendix C. Open Issues

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

Refer to the github issue tracker for any open issues:

<https://github.com/netconf-wg/yang-patch/issues>

Appendix D. Example YANG Module

The example YANG module used in this document represents a simple media jukebox interface. The "example-jukebox" YANG module is defined in [[I-D.ietf-netconf-restconf](#)].

YANG tree diagram for "example-jukebox" Module:

```
+--rw jukebox!
  +--rw library
    | +--rw artist* [name]
    | | +--rw name      string
    | | +--rw album* [name]
    | |   +--rw name      string
    | |   +--rw genre?   identityref
    | |   +--rw year?    uint16
    | |   +--rw admin
    | |   | +--rw label?          string
    | |   | +--rw catalogue-number? string
    | |   +--rw song* [name]
    | |     +--rw name      string
    | |     +--rw location  string
    | |     +--rw format?   string
    | |     +--rw length?   uint32
    | +--ro artist-count?  uint32
    | +--ro album-count?   uint32
    | +--ro song-count?    uint32
  +--rw playlist* [name]
    | +--rw name      string
    | +--rw description? string
    | +--rw song* [index]
    |   +--rw index    uint32
    |   +--rw id       leafref
  +--rw player
    +--rw gap? decimal64
```


rpcs:

```
+---x play
  +--ro input
    +--ro playlist      string
    +--ro song-number   uint32
```

D.1. YANG Patch Examples

This section includes RESTCONF examples. Most examples are shown in JSON encoding [[RFC7159](#)], and some are shown in XML encoding [[W3C.REC-xml-20081126](#)].

D.1.1. Add Resources: Error

The following example shows several songs being added to an existing album. Each edit contains one song. The first song already exists, so an error will be reported for that edit. The rest of the edits were not attempted, since the first edit failed. The XML encoding is used in this example.

Request from the RESTCONF client:


```
PATCH /restconf/data/example-jukebox:jukebox/
  library/artist=Foo%20Fighters/album=Wasting%20Light HTTP/1.1
Host: example.com
Accept: application/yang-data
Content-Type: application/yang-patch+xml

<yang-patch xmlns="urn:ietf:params:xml:ns:yang:ietf-yang-patch">
  <patch-id>add-songs-patch</patch-id>
  <edit>
    <edit-id>edit1</edit-id>
    <operation>create</operation>
    <target>/song=Bridge%20Burning</target>
    <value>
      <song xmlns="http://example.com/ns/example-jukebox">
        <name>Bridge Burning</name>
        <location>/media/bridge_burning.mp3</location>
        <format>MP3</format>
        <length>288</length>
      </song>
    </value>
  </edit>
  <edit>
    <edit-id>edit2</edit-id>
    <operation>create</operation>
    <target>/song=Rope</target>
    <value>
      <song xmlns="http://example.com/ns/example-jukebox">
        <name>Rope</name>
        <location>/media/rope.mp3</location>
        <format>MP3</format>
        <length>259</length>
      </song>
    </value>
  </edit>
  <edit>
    <edit-id>edit3</edit-id>
    <operation>create</operation>
    <target>/song=Dear%20Rosemary</target>
    <value>
      <song xmlns="http://example.com/ns/example-jukebox">
        <name>Dear Rosemary</name>
        <location>/media/dear_rosemary.mp3</location>
        <format>MP3</format>
        <length>269</length>
      </song>
    </value>
  </edit>
</yang-patch>
```


XML Response from the RESTCONF server:

```
HTTP/1.1 409 Conflict
Date: Mon, 23 Apr 2012 13:01:20 GMT
Server: example-server
Last-Modified: Mon, 23 Apr 2012 13:01:20 GMT
Content-Type: application/yang-data

<yang-patch-status
  xmlns="urn:ietf:params:xml:ns:yang:ietf-yang-patch">
  <patch-id>add-songs-patch</patch-id>
  <edit-status>
    <edit>
      <edit-id>edit1</edit-id>
      <errors>
        <error>
          <error-type>application</error-type>
          <error-tag>data-exists</error-tag>
          <error-path
            xmlns:jb="http://example.com/ns/example-jukebox">
            /jb:jukebox/jb:library
            /jb:artist[jb:name='Foo Fighters']
            /jb:album[jb:name='Wasting Light']
            /jb:song[jb:name='Burning Light']
          </error-path>
          <error-message>
            Data already exists, cannot be created
          </error-message>
        </error>
      </errors>
    </edit>
  </edit-status>
</yang-patch-status>
```

JSON Response from the RESTCONF server:

The following response is shown in JSON format to highlight the difference in the "error-path" object encoding. For JSON, the instance-identifier encoding in the "JSON Encoding of YANG Data" draft is used.


```
HTTP/1.1 409 Conflict
Date: Mon, 23 Apr 2012 13:01:20 GMT
Server: example-server
Last-Modified: Mon, 23 Apr 2012 13:01:20 GMT
Content-Type: application/yang-data+json
```

```
{
  "ietf-yang-patch:yang-patch-status" : {
    "patch-id" : "add-songs-patch",
    "edit-status" : {
      "edit" : [
        {
          "edit-id" : "edit1",
          "errors" : {
            "error" : [
              {
                "error-type": "application",
                "error-tag": "data-exists",
                "error-path": "/example-jukebox:jukebox/library\
                              /artist[name='Foo Fighters']\
                              /album[name='Wasting Light']\
                              /song[name='Burning Light']",
                "error-message":
                  "Data already exists, cannot be created"
              }
            ]
          }
        }
      ]
    }
  }
}
```

[D.1.2.](#) Add Resources: Success

The following example shows several songs being added to an existing album.

- o Each of 2 edits contains one song.
- o Both edits succeed and new sub-resources are created

Request from the RESTCONF client:


```
PATCH /restconf/data/example-jukebox:jukebox/  
library/artist=Foo%20Fighters/album=Wasting%20Light  
HTTP/1.1
```

```
Host: example.com
```

```
Accept: application/yang-data+json
```

```
Content-Type: application/yang-patch+json
```

```
{  
  "ietf-yang-patch:yang-patch" : {  
    "patch-id" : "add-songs-patch-2",  
    "edit" : [  
      {  
        "edit-id" : "edit1",  
        "operation" : "create",  
        "target" : "/song=Rope",  
        "value" : {  
          "song" : {  
            "name" : "Rope",  
            "location" : "/media/rope.mp3",  
            "format" : "MP3",  
            "length" : 259  
          }  
        }  
      },  
      {  
        "edit-id" : "edit2",  
        "operation" : "create",  
        "target" : "/song=Dear%20Rosemary",  
        "value" : {  
          "song" : {  
            "name" : "Dear Rosemary",  
            "location" : "/media/dear_rosemary.mp3",  
            "format" : "MP3",  
            "length" : 269  
          }  
        }  
      }  
    ]  
  }  
}
```

Response from the RESTCONF server:


```
HTTP/1.1 200 Success
Date: Mon, 23 Apr 2012 13:01:20 GMT
Server: example-server
Last-Modified: Mon, 23 Apr 2012 13:01:20 GMT
Content-Type: application/yang-data+json
```

```
{
  "ietf-yang-patch:yang-patch-status" : {
    "patch-id" : "add-songs-patch-2",
    "ok" : [null]
  }
}
```

D.1.3. Insert list entry example

The following example shows a song being inserted within an existing playlist. Song "6" in playlist "Foo-One" is being inserted after song "5" in the playlist. The operation succeeds, so a non-error reply example can be shown.

Request from the RESTCONF client:

```
PATCH /restconf/data/example-jukebox:jukebox/
  playlist=Foo-One HTTP/1.1
Host: example.com
Accept: application/yang-data+json
Content-Type: application/yang-patch+json

{
  "ietf-yang-patch:yang-patch" : {
    "patch-id" : "move-song-patch",
    "comment" : "Insert song 6 after song 5",
    "edit" : [
      {
        "edit-id" : "edit1",
        "operation" : "insert",
        "target" : "/song=6",
        "point" : "/song=5",
        "where" : "after",
        "value" : {
          "example-jukebox:song" : {
            "name" : "Dear Prudence",
            "location" : "/media/dear_prudence.mp3",
            "format" : "MP3",
            "length" : 236
          }
        }
      }
    ]
  }
}
```

Response from the RESTCONF server:

```
HTTP/1.1 400 OK
Date: Mon, 23 Apr 2012 13:01:20 GMT
Server: example-server
Last-Modified: Mon, 23 Apr 2012 13:01:20 GMT
Content-Type: application/yang-data+json

{
  "ietf-restconf:yang-patch-status" : {
    "patch-id" : "move-song-patch",
    "ok" : [null]
  }
}
```


D.1.4. Move list entry example

The following example shows a song being moved within an existing playlist. Song "1" in playlist "Foo-One" is being moved after song "3" in the playlist. Note that no "value" parameter is needed for a "move" operation. The operation succeeds, so a non-error reply example can be shown.

Request from the RESTCONF client:

```
PATCH /restconf/data/example-jukebox:jukebox/
  playlist=Foo-One HTTP/1.1
Host: example.com
Accept: application/yang-data+json
Content-Type: application/yang-patch+json
```

```
{
  "ietf-yang-patch:yang-patch" : {
    "patch-id" : "move-song-patch",
    "comment" : "Move song 1 after song 3",
    "edit" : [
      {
        "edit-id" : "edit1",
        "operation" : "move",
        "target" : "/song=1",
        "point" : "/song=3",
        "where" : "after"
      }
    ]
  }
}
```

Response from the RESTCONF server:

```
HTTP/1.1 400 OK
Date: Mon, 23 Apr 2012 13:01:20 GMT
Server: example-server
Last-Modified: Mon, 23 Apr 2012 13:01:20 GMT
Content-Type: application/yang-data+json
```

```
{
  "ietf-restconf:yang-patch-status" : {
    "patch-id" : "move-song-patch",
    "ok" : [null]
  }
}
```


D.1.5. Edit datastore resource example

The following example shows how 3 top-level data nodes from different modules can be edited at the same time.

Example module "foo" defines leaf X. Example module "bar" defines container Y, with child leafs A and B. Example module "baz" defines list Z, with key C and child leafs D and E.

Request from the RESTCONF client:

```
PATCH /restconf/data HTTP/1.1
Host: example.com
Accept: application/yang-data+json
Content-Type: application/yang-patch+json

{
  "ietf-yang-patch:yang-patch" : {
    "patch-id" : "datastore-patch-1",
    "comment" : "Edit 3 top-level data nodes at once",
    "edit" : [
      {
        "edit-id" : "edit1",
        "operation" : "create",
        "target" : "/foo:X",
        "value" : {
          "foo:X" : 42
        }
      },
      {
        "edit-id" : "edit2",
        "operation" : "merge",
        "target" : "/bar:Y",
        "value" : {
          "bar:Y" : {
            "A" : "test1",
            "B" : 99
          }
        }
      },
      {
        "edit-id" : "edit3",
        "operation" : "replace",
        "target" : "/baz:Z=2",
        "value" : {
          "baz:Z" : {
            "C" : 2,
            "D" : 100,
            "E" : false
          }
        }
      }
    ]
  }
}
```

Response from the RESTCONF server:


```
HTTP/1.1 400 OK
Date: Mon, 23 Apr 2012 13:02:20 GMT
Server: example-server
Last-Modified: Mon, 23 Apr 2012 13:01:20 GMT
Content-Type: application/yang-data+json
```

```
{
  "ietf-restconf:yang-patch-status" : {
    "patch-id" : "datastore-patch-1",
    "ok" : [null]
  }
}
```

Authors' Addresses

Andy Bierman
YumaWorks

Email: andy@yumaworks.com

Martin Bjorklund
Tail-f Systems

Email: mbj@tail-f.com

Kent Watsen
Juniper Networks

Email: kwatsen@juniper.net

