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Discrepancy detection between NMDA datastores
draft-clemm-netconf-nmda-diff-00

Abstract

This document defines a capability that allows to report discrepancies between management datastores in Netconf or Restconf servers that comply with the NMDA architecture. The capability is based on a set of RPCs that are defined as part of a YANG data model and that are intended to be used in conjunction with Netconf and Restconf.

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1. Introduction

The revised Network Management Datastore Architecture (NMDA) [NMDA] introduces a set of new datastores that each hold YANG-defined data [RFC7950] and represent a different "viewpoint" on the data that is maintained by a server. New YANG datastores that are introduced include <intended>, which contains validated configuration data that a client application intends to be in effect, and <operational>, which contains at least conceptually operational state data (such as statistics) as well as configuration data that is actually in effect.

NMDA introduces in effect a concept of "lifecycle" for management data, allowing to clearly distinguish between data that is part of a configuration that was supplied by a user, configuration data that has actually been successfully applied and that is part of the operational state, and overall operational state that includes both applied configuration data as well as status and statistics.

As a result, data from the same management model can be reflected in multiple datastores. Clients need to specify the target datastore to be specific about which viewpoint of the data they want to access. This way, an application can differentiate whether they are (for example) interested in the configuration that has been applied and is actually in effect, or in the configuration that was supplied by a client and that is supposed to be in effect.

Due to the fact that data can propagate from one datastore to another, it is possibly for discrepancies to occur. Some of this is entirely expected, as there may be a time lag between when a configuration is applied to the device and reflected e.g. in <intended>, until when it actually takes effect and is reflected in

<operational>. However, there may be cases when a configuration item that was to be applied may not actually take effect at all or needs an unusually long time to do so. This can be the case due to certain conditions not being met, resource dependencies not being resolved, or even implementation errors in corner conditions.

When configuration that is in effect is different from configuration that was applied, many issues can result. It becomes more difficult to operate the network properly due to limited visibility of actual status which makes it more difficult to analyze and understand what is going on in the network. Services may be negatively affected (for example, breaking a service instance resulting in service is not properly delivered to a customer) and network resources be misallocated.

Applications can potentially analyze any discrepancies between two datastores by retrieving the contents from both datastores and comparing them. However, in many cases this will be at the same time costly and extremely wasteful. It will also not be an effective approach to discover changes that are only "fleeting", or for that matter to distinguish between changes that are only fleeting from ones that are not and that may represent a real operational issue and inconsistency within the device.

This document introduces a YANG data model which defines RPCs, intended to be used in conjunction with NETCONF [RFC6241] or RESTCONF [RFC8040], that allow a client to request a server to compare two NMDA datastores and report any discepancies. It also features a dampening option that allows to exclude discrepancies that are only fleeting from the report.

2. Key Words

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Definitions and Acronyms

NMDA: Network Management Datastore Architecture

RPC: Remote Procedure Call

4. Data Model Overview

At the core of the solution is a new management operation, <compare>, that allows to compare two datastores for the same data. The operation checks whether there are any discrepancies in values or in objects that are contained in either datastore, and returns any discrepancies as output. The output is returned in the format specified in YANG-Patch [RFC8072].

The YANG data model defines the <compare> operation as a new RPC. The operation takes the following input parameters:

- o source: The source identifies the datastore that will serve as reference for the comparison, for example <intended>.

- o target: The target identifies the datastore to compare against the source.

- o filter-spec: This is a choice between different filter constructs to identify the portions of the datastore to be retrieved. It acts as a node selector that specifies which data nodes are within the scope of the comparison and which nodes are outside the scope. (The filter dow not contain expressions that would match values data nodes, as this is not required by most use cases and would complicate the scheme, from implementation to dealing with race conditions.)

- o dampening: Identifies the minimum time period for which a discrepancy must persist for it to be reported.

The operation provides the following output parameter:

- o differences: This parameter contains the list of differences, encoded per RFC8072, i.e. specifying which patches would need to be applied to the source to produce the target.

The structure of the YANG data model is depicted in the diagram below. The notation syntax follows [I-D.draft-ietf-netmod-yang-tree-diagrams].

```
   module: ietf-nmda-compare

     rpcs:
       +---x compare
          +---w input
          |  +---w source            identityref
          |  +---w target            identityref
          |  +---w (filter-spec)?
          |  |  +--:(subtree-filter)
          |  |  |  +---w subtree-filter?   <anydata>
          |  |  +--:(xpath-filter)
          |  |     +---w xpath-filter?     yang:xpath1.0 {nc:xpath}?
          |  +---w dampening?        yang:timeticks
          +--ro output
             +--ro differences
```

5. YANG Data Model

```
<CODE BEGINS> file "ietf-nmda-compare@2017-10-05.yang"
module ietf-nmda-compare {

  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-nmda-compare";

  prefix cp;

  import ietf-yang-types {
    prefix yang;
  }
  import ietf-datastores {
    prefix ds;
  }
  import ietf-yang-patch {
    prefix ypatch;
  }
  import ietf-netconf {
    prefix nc;
  }

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

     Author: Alexander Clemm
             <mailto:ludwig@clemm.org>

     Author: Yingzhen Qu
```

```
             <mailto:yingzhen.qu@huawei.com>

        Author: Jeff Tantsura
             <mailto:jefftant.ietf@gmail.com>";

  description
    "The YANG data model defines a new operation, <compare>, that
     can be used to compare NMDA datastores.";

  revision 2017-10-05 {
    description
      "Initial revision";
    reference
      "RFC XXXX: Discrepancy detection between NMDA datastores";
  }

  /* RPC */
  rpc compare {
    description
      "NMDA compare operation.";
    input {
      leaf source {
        type identityref {
          base ds:datastore;
        }
        mandatory true;
        description
          "The source datastore to be compared.";
      }
      leaf target {
        type identityref {
          base ds:datastore;
        }
        mandatory true;
        description
          "The target datastore to be compared.";
      }
          choice filter-spec {
        description
          "Identifies the portions of the datastores to be
               compared.";

        anydata 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 dampening {
        type yang:timeticks;
        default "0";
        description
          "The dampening period, in hundredths of a second, for the
                   reporting of differences. Only differences that pertain
                   for at least the dampening time are reported.  A value of
                   0 indicates no dampening.";
      }
    }
    output {
      container differences {
        uses ypatch:yang-patch;
        description
          "The list of differences, encoded per RFC8072.";
      }
    }
  }
}
<CODE ENDS>
```

6. IANA Considerations

6.1. Updates to the IETF XML Registry

This document registers one URI in the IETF XML registry [RFC3688]. Following the format in [RFC3688], the following registration is requested:

URI: urn:ietf:params:xml:ns:yang:ietf-nmda-compare

Registrant Contact: The IESG.

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

6.2. Updates to the YANG Module Names Registry

This document registers a YANG module in the YANG Module Names registry [RFC6020]. Following the format in [RFC6020], the following registration is requested:

name: ietf-nmda-compare

namespace: urn:ietf:params:xml:ns:yang:ietf-nmda-compare

prefix: cp

reference: RFC XXXX

7. Security Considerations

Comparing discrepancies between datastores requires a certain amount of processing resources at the server. An attacker could attempt to attack a server by making a high volume of discrepancy detection requests. Server implementations can guard against such scenarios in several ways. For one, they can implement NACM in order to require proper authorization for requests to be made. Second, server implementations can limit the number of requests that they serve in any one time interval, potentially rejecting requests made at a higher frequency than the implementation can reasonably sustain.

8. Normative References

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[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

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