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Self Describing Data Object Tags
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Abstract

This document defines a method to tag data objects associated with operation and management data in YANG Modules. This YANG data object tagging method can be used to classify data objects from different YANG modules and identify characteristics data. It also can provide input, instruction, indication to selection filter and filter queries of operational state on a server during a "pub/sub" service for YANG datastore updates. When the state of all subscriptions of a particular Subscriber to be fetched is huge, the amount of data to be streamed out to the destination can be greatly reduced and only targeted to the characteristics data. These data object tags may be registered as well as assigned during the module definition; assigned by implementations; or dynamically defined and set by users.

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1. Introduction

As described in [I.D-ietf-netmod-module-tags], the use of tags for classification and organization is fairly ubiquitous not only within IETF protocols, but in the internet itself (e.g., "#hashtags"). A module tag defined in [I.D-ietf-netmod-module-tags] is a string associated only with a module name at module level.

At the time of writing this document (2020), there are many data models that have been specified or are being specified by various different SDOs and Open Souce community. They cover many of the networking protocols and techniques. However data objects defined by these technology specific data models might represent a portion of fault, configuration, accounting, performance, security management categories information at different locations in various different ways, lack consistent classification criteria and representation for a specific service, feature or data source.

This document defines self-describing data object tags and associates them with data objects within YANG module, which

- Provide dictionary meaning for specific targeted data objects;
- Indicate relationship between data objects within the same YANG module or from different YANG modules;
- Identify key performance metric data objects and the absolute XPath expression identifying the element path to the node;

The self describing data object tags can be used by the client to classify data objects from different YANG modules and identify characteristics data. In addition, it can provide input, instruction, indication to selection filter and filter queries of configuration or operational state on a server based on these data object tags, .e.g., return specific object type of operational state related to system-management. NETCONF clients can discover data objects with self describing data object tags supported by a NETCONF server via <get-schema> operation. The self describing data object tag capability can also be advertised via Capability Notification Model [I-D.netconf-notification-capabilities] by the NETCONF server or some place where offline document are kept. These data object tags may be registered as well as assigned during the module definition; assigned by implementations; or dynamically defined and set by users.

This document defines a YANG module [RFC7950] which augments module tag model and provides a list of data object entries to allow for adding or removing of self describing tags as well as viewing the set of self describing tags associated with specific data objects within YANG modules.

This document defines an extension statement to be used to indicate self describing tags that SHOULD be added by the module implementation automatically (i.e., outside of configuration).

This document also defines an IANA registry for tag prefixes as well as a set of globally assigned tags.

Section 6 provides guidelines for authors of YANG data models.

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

1.1. Self Describing Data Object Tags Use Case

1.1.1. Massive Data Object Collection

Among data object tags, the opm (object, property subobject, metric subobject) tags can be used to tackle massive data objects collection and only capture YANG data objects associated with performance metrics data modelled with YANG (See Figure 1).

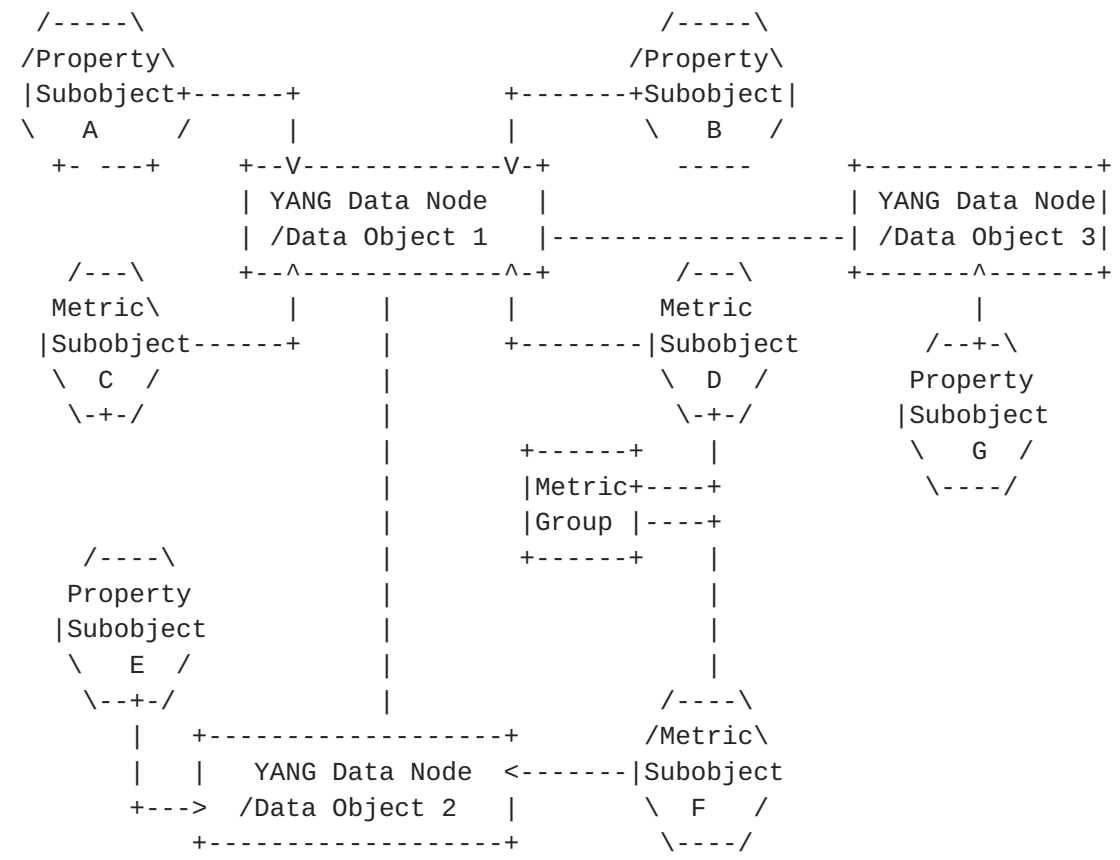

Figure 1: The Relation between Object, Property and Metric

In Figure 1, object can contain other objects called subobjects. Property and metric objects are both subobjects belonging to specific object. Both object and subobjects can be modeled as YANG data nodes [RFC7950]. Object can be one of container, leaf-list and list. Property subobject is a leaf node. Metric subobject can be one of container, leaf-list, list, leaf node. Object contains zero or many property subobjects, zero or many metric subobjects.

The use of opm tags would be to help filter discrete categories of YANG data objects scattered across the same or different YANG modules supported by a device and capture all network performance data or all property data in the single view of the truth (see Figure 2). In Figure 2, tunnel-svc data object is a container node in the tunnel-pm module and can be seen as the root object for property subobjects (e.g., tunnel-svc/create-time) and metric subobjects (e.g.,tunnel-svc/avg-latency). Name, create-time, modified-time are property subobjects under tunnel-svc container. Avg-latency,packet loss are metric subobjects under tunnel-svc container node. In addition, not all metric subobjects need to be tagged, e.g., only specific category (e.g., loss related) metric subobjects need to be tagged with metric-group tag which can further reduce amount data to be fetched.

Data Object	Object Tag	Property Subobject Tag	Metric Subobject Tag	Module Name
	ietf: object			tunnel-pm
tunnel-svc		ietf: property		tunnel-pm
tunnel-svc/name		ietf: property		tunnel-pm
tunnel-svc/create-time		ietf: property		tunnel-pm
tunnel-svc/modified-time				
tunnel-svc/avg-latency			ietf: metric	tunnel-pm
tunnel-svc/packet-loss			ietf: metric	tunnel-pm
tunnel-svc/min-latency			ietf: metric	tunnel-pm
tunnel-svc/ max-latency			ietf: metric	tunnel-pm

Figure 2: Example of OPM Tags Used in the YANG Module

If data objects in these YANG modules are suitably tagged and learnt by the client from a live server, the client can retrieve paths to all targeted data objects and then use an XPath query defined [RFC8639] [RFC8641] to list all tagged data objects which reflect network characteristics

1.2. Terminology

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

2. Data Object Tag Values

All data object tags SHOULD begin with a prefix indicating who owns their definition. An IANA registry (Section 7.1) is used to support registering data object tag prefixes. Currently 3 prefixes are defined.

No further structure is imposed by this document on the value following the registered prefix, and the value can contain any YANG type 'string' characters except carriage-returns, newlines and tabs. Therefore, designers, implementers, and users are free to add or not add any structure they may require to their own tag values.

2.1. IETF Tags Prefix

An IETF tag is a data object tag that has the prefix "ietf:". All IETF data object tags are registered with IANA in a registry defined later in this document (Section 7.2).

2.2. Vendor Tags Prefix

A vendor tag is a tag that has the prefix "vendor:". These tags are defined by the vendor that implements the module, and are not registered; however, it is RECOMMENDED that the vendor include extra identification in the tag to avoid collisions such as using the enterprise or organization name following the "vendor:" prefix (e.g., vendor:vendor-defined-classifier).

2.3. User Tags Prefix

A user tag is any tag that has the prefix "user:". These tags are defined by the user/administrator and are not meant to be registered. Users are not required to use the "user:" prefix; however, doing so is RECOMMENDED as it helps avoid prefix collisions.

2.4. Reserved Tags Prefix

Any tag not starting with the prefix "ietf:", "vendor:" or "user:" is reserved for future use. These tag values are not invalid, but simply reserved in the context of specifications (e.g., RFCs).

3. Data Object Tag Management

Tags can become associated with a data object within YANG module in a number of ways. Tags may be defined and associated at the module design time, at implementation time without the need of live server, or via user administrative control . As the main consumer of data object tags are users, users may also remove any tag from a live server, no matter how the tag became associated with a data object within a YANG module.

3.1. Module Design Tagging

A data object definition MAY indicate a set of data object tags to be added by the module implementer. These design time tags are indicated using a set of extension statements which include:

opm-tag extension statement: Classify management and operation data into object, property subobject and metric subobject three categories. Object can contain other objects called subobjects. Property and metric objects are both subobjects belonging to specific object. Both object and subobjects can be modeled as data nodes [RFC7950]. Object can be one of container, leaf-list and list. Property subobject is a leaf node. Metric subobject can be one of container, leaf-list, list, leaf. Object contains zero or many property subobjects, zero or many metric subobjects. See opm-tag example in Figure 2 and Figure 3.

metric-group extension statement: Provide meric subobjects classification (e.g., loss, jitter, delay) within the YANG module.

multi-source-tag extension statement: Identify multi-source aggregation type (e.g., aggregated, non-aggregated) related to metric subobject. 'aggregated' multi-source aggregation type allows a large number of measurements on metric subobjects from different sources of the same type (e.g.,line card, each subinterface of aggregated Ethernet interface) being combined into aggregated statistics and report as one metric subobject. 'non-aggregated' multi-source aggregation type allows measurement from each source of the same type (e.g.,line card, each subinterface of aggregated Ethernet interface) be reported separately.

Among these extension statements, the metric-group, multi-source-tag extension statements are context information related and can be used to correlate data object from the different modules.

If the data node is defined in an IETF standards track document, the data object tags MUST be IETF Tags (2.1). Thus, new data object can drive the addition of new IETF tags to the IANA registry defined in Section 7, and the IANA registry can serve as a check against duplication.

3.2. Implementation Tagging

An implementation MAY include additional tags associated with data object within a YANG module. These tags SHOULD be IETF Tags (i.e., registered) or vendor specific tags.

3.3. User Tagging

Data object tags of any kind, with or without a prefix, can be assigned and removed by the user from a live server using normal configuration mechanisms. In order to remove a data object tag from the operational datastore, the user adds a matching "masked-tag" entry for a given data object within the ietf-data-object-tags Module.

4. Data Object Tags Module Structure

4.1. Data Object Tags Module Tree

The tree associated with the "ietf-data-object-tags" module follows. The meaning of the symbols can be found in [RFC8340].

```
module: ietf-data-object-tags
  augment /tags:module-tags/tags:module:
    +--rw data-object-tags
       +--rw data-object* [object-name]
          +--rw object-name    nacm:node-instance-identifier
          +--rw tag*           tags:tag
          +--rw masked-tag*    tags:tag
```

5. YANG Module

```
<CODE BEGINS> file "ietf-data-object-tags@2019-05-03.yang"
module ietf-data-object-tags {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-data-object-tags";
  prefix ntags;

  import ietf-netconf-acm {
    prefix nacm;
  }
  import ietf-module-tags {
    prefix tags;
  }

  organization
    "IETF NetMod Working Group (NetMod)";
  contact
    "WG Web:  <https://tools.ietf.org/wg/netmod/>
     WG List: <mailto:netmod@ietf.org>
     Editor:  Qin Wu <mailto:bill.wu@huawei.com>
     Editor:  Benoit Claise <mailto:bclaise@cisco.com>
     Editor:  Liang Geng <mailto:gengliang@chinamobile.com>
     Editor:  Zongpeng Du <mailto:duzongpeng@chinamobile.com>
```

```
     Editor:  Mohamed Boucadair <mailto:mohamed.boucadair@orange.com>";
  description
    "This module describes a mechanism associating self-describing
     tags with YANG data object within YANG modules. Tags may be IANA
     assigned or privately defined.

     Copyright (c) 2020 IETF Trust and the persons identified as
     authors of the code. All rights reserved.

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

     This version of this YANG module is part of RFC XXXX
     (https://tools.ietf.org/html/rfcXXXX); see the RFC itself for
     full legal notices.";

  revision 2019-05-03 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: YANG Data Object Tags";
  }

  extension opm-tag {
    argument tag;
    description
      "The argument 'tag' is of type 'tag'. This extension statement
       is used by module authors to indicate the opm tags that SHOULD be
       added automatically by the system. Opm Tag is used to classify
       operation and management data into object, property subobject, and
metric
       subobject three categories. Object can contain other objects called
subobjects.
       Property and metric objects are both subobjects belonging to specific
object.
       Both object and subobjects can be modeled as data nodes. Object can be
one of
       container, leaf-list and list. Property subobject is a leaf node. Metric
subobject
       can be one of container, leaf-list, list, leaf. Object contains zero or
many
       property subobjects, zero or many metric subobjects. As such the origin
of the
       value for the pre-defined tags should be set to 'system'[RFC8342].";
```

```
  }

  extension metric-group {
    argument tag;
    description
      "The argument 'tag' is of type 'tag'.The metric-group can be
       used to provide metric subobject classification
```

```
       (e.g., loss, jitter, packet loss) within the YANG module.";
  }

  extension multi-source-tag {
    argument tag;
    description
      "The argument 'tag' is of type 'tag'.The multi-source-tag can be
       used to identify  multi-source aggregation type (e.g., aggregated,
       non-aggregated) related to metric subobject.

      'aggregated' multi-source aggregation type allows a large number of
      measurements on metric subobjects from different sources of the same
      type (e.g.,line card, each subinterface of aggregated Ethernet interface)
      being combined into aggregated statistics and report as one metric
subobject
      value. 'non-aggregated' multi-source aggregation type allows measurement
from
      each source of the same type (e.g.,line card, each subinterface of
aggregated
      Ethernet interface) be reported separately.";
   }

  augment "/tags:module-tags/tags:module" {
    description
      "Augment the Module Tags module with data object tag attributes";
    container data-object-tags {
      description
        "Contains the list of data objects and their associated data object
tags";
      list data-object {
        key "object-name";
        description
          "A list of data objects and their associated data object tags";
        leaf object-name {
          type nacm:node-instance-identifier;
          mandatory true;
          description
            "The YANG data object name.";
        }
        leaf-list tag {
          type tags:tag;
          description
            "Tags associated with the data object within the YANG module. See
             the IANA 'YANG Data Object Tag Prefixes' registry for reserved
             prefixes and the IANA'IETF YANG Data Object Tags' registry for
             IETF tags.

             The 'operational' state [RFC8342] view of this list is
```

constructed using the following steps:

1) System tags (i.e., tags of 'system' origin) are added.
2) User configured tags (i.e., tags of 'intended' origin)

```
              are added.
              3) Any tag that is equal to a masked-tag is removed.";
          }
          leaf-list masked-tag {
            type tags:tag;
            description
              "The list of tags that should not be associated with the data
               object within the YANG module. The user can remove (mask) tags
from the
               operational state datastore [RFC8342] by adding them to
               this list. It is not an error to add tags to this list
               that are not associated with the data object within YANG module,
               but they have no operational effect.";
          }
        }
      }
    }
}
<CODE ENDS>
```

6. Guidelines to Model Writers

This section updates [RFC8407].

6.1. Define Standard Tags

A module MAY indicate, using data object tag extension statements, a set of data object tags that are to be automatically associated with data object within the module (i.e., not added through configuration).

```
module example-module-A {
       //...
       import ietf-data-node-tags { prefix ntags; }
       container top {
         ntags:opm-tag "ietf:object";
        list X {
          leaf foo {
          ntags:opm-tag "ietf:property";
           }
         }
       container Y {
         leaf bar {
         ntags:opm-tag "ietf:metric";
         }
     }
   }
 // ...
}
```

Figure 3: Data object tag example

The module writer can use existing standard data object tags, or use new data object tags defined in the data object definition, as appropriate. For IETF standardized modules, new data object tags MUST be assigned in the IANA registry defined below, see Section Section 7.2.

7. IANA Considerations

7.1. YANG Data Object Tag Prefixes Registry

IANA is asked to create a new registry "YANG Data Object Tag Prefixes" grouped under a new "Protocol" category named "YANG Data Object Tag Prefixes".

This registry allocates tag prefixes. All YANG Data Object Tags SHOULD begin with one of the prefixes in this registry.

Prefix entries in this registry should be short strings consisting of lowercase ASCII alpha-numeric characters and a final ":" character.

The allocation policy for this registry is Specification Required [RFC8126]. The Reference and Assignee values should be sufficient to identify and contact the organization that has been allocated the prefix.

The initial values for this registry are as follows.

Prefix	Description	Reference	Assignee
ietf:	IETF Tags allocated in the IANA IETF YANG Data Object Tags registry	[This document]	IETF
vendor:	Non-registered tags allocated by the module implementer.	[This document]	IETF
user:	Non-registered tags allocated by and for the user.	[This document]	IETF

Other standards organizations (SDOs) wishing to allocate their own set of tags should allocate a prefix from this registry.

7.2. IETF YANG Data Object Tags Registry

IANA is asked to create 3 new registries "IETF OPM Tags","IETF Metric Group Tags","IETF Multiple Source Tags" grouped under a new "Protocol" category. These 3 registries should be included below "YANG Data Object Tag Prefixes" when listed on the same page.

3 registries allocate tags that have the registered prefix "ietf:". New values should be well considered and not achievable through a combination of already existing IETF tags.

The allocation policy for these three registries is IETF Review [RFC8126].

The initial values for these three registries are as follows.

OPM Tag	Description	Reference
ietf:object	Represent specific object type(e.g., interfaces).	[This document]
ietf:property	Represent a property subobject (e.g.,ifindex) assoiciated with specific object (e.g.,interfaces).	[This document]
ietf:metric	Represent metric subobject (e.g., ifstatistics) associated with specific object(e.g.,interfaces)	[This document]

Metric Group Tag	Description	Reference
ietf:delay	Represent the metric group which metric subobjects belong to (i.e., delay)	[This document]
ietf:jitter	Represent the metric group which metric subobjects belong to (i.e., jitter)	[This document]
ietf:loss	Represent the metric group which metric subobjects belong to (i.e.,loss)	[This document]

Multiple Source Tag	Description	Reference
ietf:non-agg	Relate to multiple source aggregation type(i.e., aggregated statistics)	[This document]
ietf:agg	Relate to multiple source aggregation type(i.e., non aggregated statistics)	[This document]

Each YANG data object can have one opm tag, zero or one metric-group tag, zero or one multi-source tag.

7.3. Updates to the IETF XML Registry

This document registers a URI in the "IETF XML Registry" [RFC3688]. Following the format in [RFC3688], the following registration has been made:

```
URI:
   urn:ietf:params:xml:ns:yang:ietf-data-object-tags
Registrant Contact:
   The IESG.
XML:
   N/A; the requested URI is an XML namespace.
```

7.4. Updates to the YANG Module Names Registry

This document registers one YANG module in the "YANG Module Names" registry [RFC6020]. Following the format in [RFC6020], the following registration has been made:

```
name:
   ietf-data-object-tags
namespace:
   urn:ietf:params:xml:ns:yang:ietf-data-object-tags
prefix:
   ntags
reference:
   RFC XXXX (RFC Ed.: replace XXX with actual RFC number and remove
   this note.)
```

8. Security Considerations

The YANG module defined in this memo is designed to be accessed via the NETCONF protocol [RFC6241]. The lowest NETCONF layer is the secure transport layer and the mandatory-to-implement secure transport is SSH [RFC6242].

This document adds the ability to associate data object tag meta-data with data object within the YANG modules. This document does not define any actions based on these associations, and none are yet defined, and therefore it does not by itself introduce any new security considerations.

Users of the data object tag meta-data may define various actions to be taken based on the data object tag meta-data. These actions and their definitions are outside the scope of this document. Users will need to consider the security implications of any actions they choose to define.

9. Acknowledgements

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Appendix A. NETCONF Example

The following is a fictional NETCONF example result from a query of the data object tags list. For the sake of brevity only a few module and associated data object results are imagined.

```
<ns0:data xmlns:ns0="urn:ietf:params:xml:ns:netconf:base:1.0">
  <t:module-tags xmlns:t="urn:ietf:params:xml:ns:yang:ietf-module-tags">
    <t:module>
       <t:name>ietf-interfaces</t:name>
       <s:data-object-tags xmlns:s="urn:ietf:params:xml:ns:yang:ietf-data-
object-tags">
        <s:data-object>
         <s:object-name>/if:interfaces/if:interface</s:object-name>
         <s:tag>ietf:object</s:tag>
        </s:data-object>
       <s:data-object>
        <s:object-name>/if:interfaces/if:interface/if:last-change</s:object-
name>
        <s:tag>ietf:property</s:tag>
       </s:data-object>
        <s:data-object>
         <s:object-name>
          /if:interfaces/if:interface/if:statistics/if:in-errors
         </s:object-name>
         <s:tag>ietf:metric</s:tag>
        </s:data-object>
      </s:data-object-tags>
    </t:module>
    <t:module>
       <t:name>ietf-ip</t:name>
       <s:data-object-tags xmlns:s="urn:ietf:params:xml:ns:yang:ietf-data-
object-tags">
       <s:data-object>
         <s:object-name>/if:interfaces/if:interface/ip:ipv4</s:object-name>
         <s:tag>ietf:object</s:tag>
       </s:data-object>
       <s:data-object>
         <s:object-name>/if:interfaces/if:interface/ip:ipv4/ip:enable</
s:object-name>
         <s:tag>ietf:property</s:tag>
       </s:data-object>
        <s:data-object>
        <s:object-name>/if:interfaces/if:interface/ip:ipv4/ip:mtu</s:object-
name>
        <s:tag>ietf:metric</s:tag>
       </s:data-object>
      </s:data-object-tags>
    </t:module>
  </t:module-tags>
</ns0:data>
```

Appendix B. Non-NMDA State Module

As per [RFC8407] the following is a non-NMDA module to support viewing the operational state for non-NMDA compliant servers.

```
<CODE BEGINS> file "ietf-data-object-tags-state@2019-05-03.yang"
module ietf-data-object-tags-state {
```

```
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-data-object-tags-state";
  prefix ntags-s;

  import ietf-netconf-acm {
    prefix nacm;
  }
  import ietf-module-tags {
    prefix tags;
  }
  organization
    "IETF NetMod Working Group (NetMod)";
  contact
    "WG Web:  <https://tools.ietf.org/wg/netmod/>
     WG List: <mailto:netmod@ietf.org>
     Editor:  Qin Wu <mailto:bill.wu@huawei.com>
     Editor:  Benoit Claise <mailto:bclaise@cisco.com>
     Editor:  Liang Geng <mailto:gengliang@chinamobile.com>
     Editor:  Zongpeng Du <mailto:duzongpeng@chinamobile.com>";
  description
    "This module describes a mechanism associating self-describing
     tags with YANG data object within YANG modules. Tags may be IANA
     assigned or privately defined.

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     authors of the code. All rights reserved.

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     without modification, is permitted pursuant to, and subject to
     the license terms contained in, the Simplified BSD License set
     forth in Section 4.c of the IETF Trust's Legal Provisions
     Relating to IETF Documents
     (https://trustee.ietf.org/license-info).

     This version of this YANG module is part of RFC XXXX
     (https://tools.ietf.org/html/rfcXXXX); see the RFC itself for
     full legal notices.";

  revision 2019-05-03 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: YANG Data Object Tags";
  }

  extension opm-tag {
    argument tag;
    description
```

```
      "The argument 'tag' is of type 'tag'. This extension statement
       is used by module authors to indicate the opm tags that SHOULD be
       added automatically by the system. Opm Tag is used to classify
       operation and management data into object, property subobject, and
metric
       subobject three categories. Object can contain other objects called
subobjects.
       Property and metric objects are both subobjects belonging to specific
object.
       Both object and subobjects can be modeled as data nodes. Object can be
one of
       container, leaf-list and list. Property subobject is a leaf node. Metric
subobject
       can be one of container, leaf-list, list, leaf. Object contains zero or
many
       property subobjects, zero or many metric subobjects. As such the origin
of the value
       for the pre-defined tags should be set to 'system'[RFC8342].";
  }
  extension metric-group {
    argument tag;
    description
      "The argument 'tag' is of type 'tag'.The metric-group can be
       used to provide metric subobject classification
       (e.g., loss, jitter, packet loss)within the YANG module.";
  }
  extension multi-source-tag {
    argument tag;
    description
      "The argument 'tag' is of type 'tag'.The multi-source-tag can be
       used to identify  multi-source aggregation type (e.g., aggregated,
       non-aggregated) related to metric subobject.

      'aggregated' multi-source aggregation type allows a large number of
      measurements on metric subobjects from different sources of the same
      type (e.g.,line card, each subinterface of aggregated Ethernet interface)
      being combined into aggregated statistics and report as one metric
subobject
      value. 'non-aggregated' multi-source aggregation type allows measurement
from
      each source of the same type (e.g.,line card, each subinterface of
aggregated
      Ethernet interface) be reported separately.";
   }

  augment "/tags:module-tags/tags:module" {
    description
      "Augment the Module Tags module with data object tag attributes";
```

```
    container data-object-tags {
      config false;
      status deprecated;
      description
        "Contains the list of data objects and their associated self describing
tags";
      list data-object {
        key "object-name";
        status deprecated;
        description
          "A list of data objects and their associated self describing tags";
```

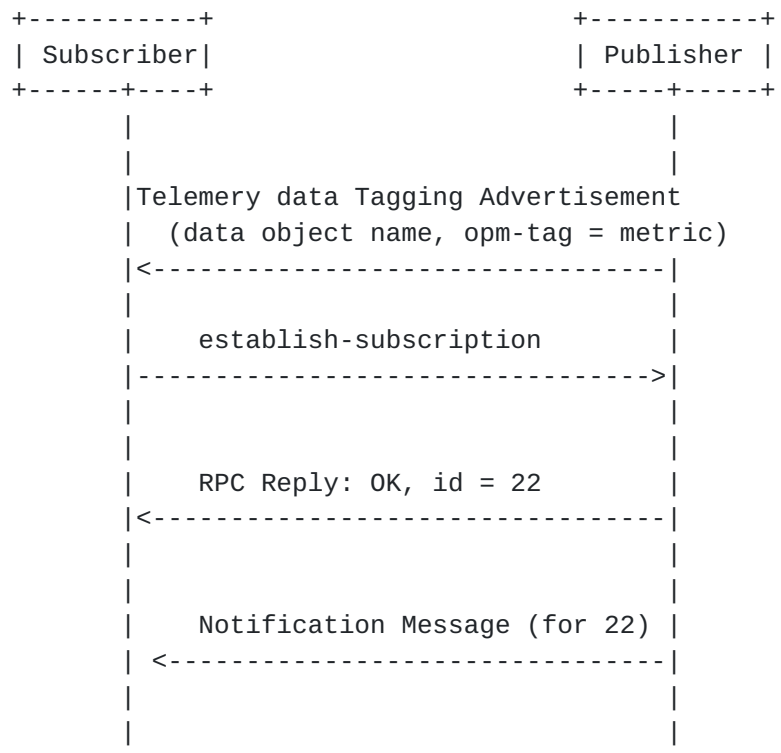
```
        leaf object-name {
          type nacm:node-instance-identifier;
          mandatory true;
          status deprecated;
          description
            "The YANG data object name.";
        }
        leaf-list tag {
          type tags:tag;
          status deprecated;
          description
            "Tags associated with the data object within the YANG module. See
             the IANA 'YANG Data Object Tag Prefixes' registry for reserved
             prefixes and the IANA'IETF YANG Data Object Tags' registry for
             IETF tags.

             The 'operational' state [RFC8342] view of this list is
             constructed using the following steps:

             1) System tags (i.e., tags of 'system' origin) are added.
             2) User configured tags (i.e., tags of 'intended' origin)
             are added.
             3) Any tag that is equal to a masked-tag is removed.";
        }
        leaf-list masked-tag {
          type tags:tag;
          status deprecated;
          description
            "The list of tags that should not be associated with the data
             object within the YANG module. The user can remove (mask) tags
from the
             operational state datastore [RFC8342] by adding them to
             this list. It is not an error to add tags to this list
             that are not associated with the data object within YANG module,
             but they have no operational effect.";
        }
      }
    }
  }
}
<CODE ENDS>
```

Appendix C. Targeted data object collection example

The following subsections provides targeted data object collection example which helps reduce amount of data to be fetched. The subscription "id" values of 22 used below is just an example. In production, the actual values of "id" might not be small integers.



The publisher advertises telemetry data object capability to the subscriber to instruct the receiver to subscribe tagged data object (e.g., performance metric data object) using standard subscribed notification mechanism [RFC8639].

The following XML example [W3C.REC-xml-20081126] illustrates the advertisment of the list of available target objects using YANG instance file format [I-D.ietf-netmod-yang-instance-file-format]:

```
<?xml version="1.0" encoding="UTF-8"?>
<instance-data-set xmlns=\
    "urn:ietf:params:xml:ns:yang:ietf-yang-instance-data">
  <name>acme-router-notification-capabilities</name>
  <content-schema>
    <module>ietf-system-capabilities@2020-03-23</module>
    <module>ietf-notification-capabilities@2020-03-23</module>
    <module>ietf-data-export-capabilities@2020-03-23</module>
  </content-schema>
  <!-- revision date, contact, etc. -->
  <description>Defines the notification capabilities of an acme-router.
    The router only has running, and operational datastores.
    Every change can be reported on-change from running, but
    only config=true nodes and some config=false data from operational.
    Statistics are not reported based on timer based trigger and counter
    threshold based trigger.
  </description>
  <content-data>
    <system-capabilities \
      xmlns="urn:ietf:params:xml:ns:yang:ietf-system-capabilities" \
      xmlns:inc=\
        "urn:ietf:params:xml:ns:yang:ietf-notification-capabilities" \
      xmlns:ds="urn:ietf:params:xml:ns:yang:ietf-datastores">
      <datastore-capabilities>
        <datastore>ds:operational</datastore>
        <per-node-capabilities>
          <node-selector>\
              /if:interfaces/if:interface/if:statistics/if:in-errors\
          </node-selector>
          <sec:self-describing-capabilities>
            <sec:opm-tag>metric</sec:opm-tag>
            <sec:metric-group>loss</sec:metric-group>
          </sec:self-describing-capabilities>
        </per-node-capabilities>
      </datastore-capabilities>
    </system-capabilities>
  </content-data>
</instance-data-set>
```

With telemetry data tagging information carried in the Telemetry data Tagging Advertisement, the subscriber identifies targeted data object and associated data path to the datastore node and sends a standard establish-subscription RPC [RFC8639] to subscribe tagged data objects that are interests to the client application from the publisher.

```
 <netconf:rpc message-id="101"
     xmlns:netconf="urn:ietf:params:xml:ns:netconf:base:1.0">
   <establish-subscription
       xmlns="urn:ietf:params:xml:ns:yang:ietf-subscribed-notifications"
       xmlns:yp="urn:ietf:params:xml:ns:yang:ietf-yang-push">
     <yp:datastore
          xmlns:ds="urn:ietf:params:xml:ns:yang:ietf-datastores">
       ds:operational
     </yp:datastore>
     <yp:datastore-xpath-filter
         xmlns:ex="https://example.com/sample-data/1.0">
       /if:interfaces/if:interface/if:statistics/if:in-errors
     </yp:datastore-xpath-filter>
     <yp:periodic>
       <yp:period>500</yp:period>
     </yp:periodic>
   </establish-subscription>
 </netconf:rpc>
```

The publisher returns specific object type of operational state (e.g., in-errors statistics data) subscribed by the client.

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