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Authors: Q. Wu B. Claise P. Liu Z. Du
 Huawei Huawei China Mobile China Mobile
 M. Boucadair
 Orange

Self Describing Data Object Tags

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 their characteristics data. It can also 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 subscriptions of a particular subscriber to be fetched is very large, the amount of data to be streamed out to the destination can be 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.

Status of This Memo

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1. Introduction

As described in [[RFC8819](#)], the use of tags for classification and organization is fairly ubiquitous not only within IETF protocols, but in the Internet itself (e.g., "#hashtags"). As a reminder, a module tag defined in [[RFC8819](#)] is a string associated only with a module name at the 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 SDOs and the Open Source community. These models 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, and security management categories information at different locations in various different ways. Let alone 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 a 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 NETCONF/RESTCONF 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 by means of <get-schema> operation. The self describing data object tag capability can also be advertised using the 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 or assigned during the module definition, assigned by implementations, or dynamically defined and set by users.

This document defines a YANG module [[RFC7950](#)] which augments the 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 9](#)).

[Section 8](#) 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](#)].

The meaning of the symbols can be found in [[RFC8340](#)].

2. Terminology

2.1. Requirements Notation

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.

2.2. Glossary

OPM Object Property Metric

3. Self Describing Data Object Tags: Massive Data Object Collection Use Case

Among data object tags, the 'opm' (object, property, metric) tags can be used to tackle massive data objects collection, indicate relationship between data objects and only capture YANG data objects associated with performance metrics data modelled with YANG ([Figure 1](#)).

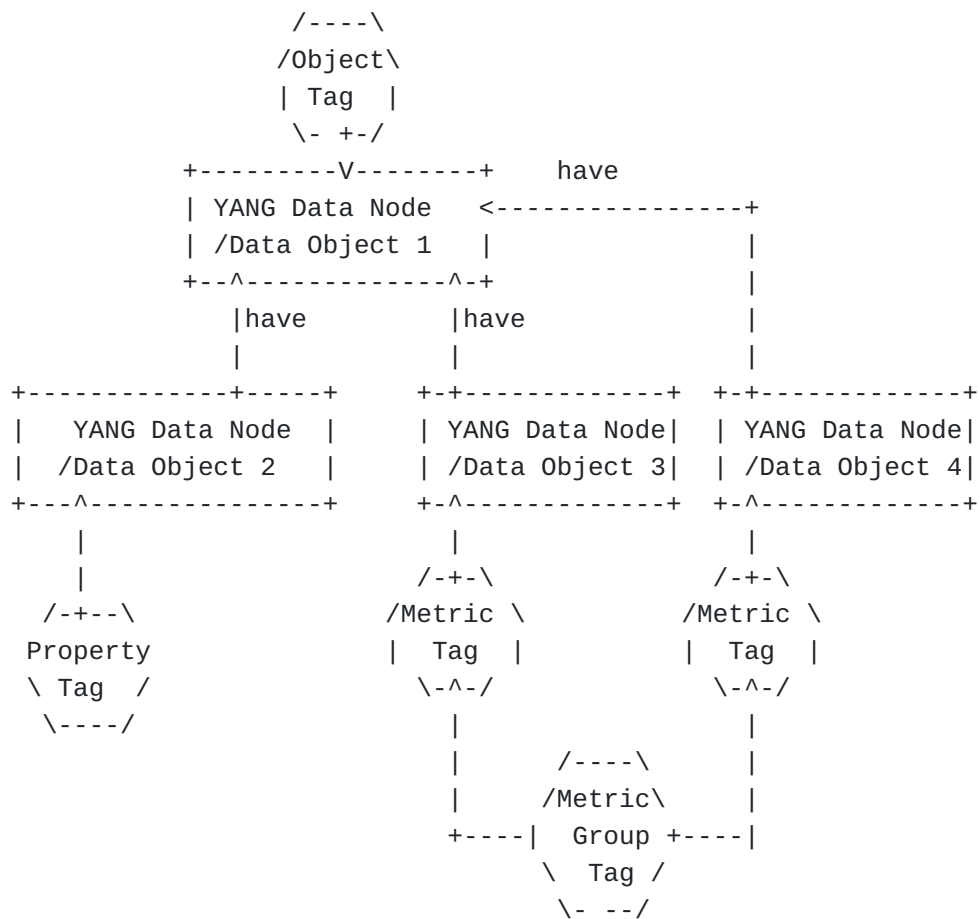


Figure 1: The Relation between Object, Property and Metric

In [Figure 1](#), data objects can contain other data objects called subobjects. Both object and subobjects can be modeled as YANG data nodes [RFC7950]. Data objects that contain other data objects can be one of 'container', 'leaf-list', and 'list' and are tagged with object tag. A subobject tagged with the property tag is a 'leaf' node. Subobjects tagged with the metric tag can be one of 'container', 'leaf-list', 'list', or 'leaf' data node.

A data object may contain one single object tag, or one single property tag, or one single metric tag. In many cases, a data object only contains one single metric tag. However the data object tagged with the metric tag also can have one or multiple MetricType tags and/or one single multi-source tag.

The use of 'opm' tags is meant 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 a single view of the data. In [Figure 2](#), 'tunnel-svc' data object is a container node defined in the 'tunnel-
pm' module and can be seen as the root object for property tagged subobjects (e.g., 'tunnel-svc'/'create-time') and metric tagged

subobjects (e.g., 'tunnel-svc'/'avg-latency'). The 'name', 'create-time', and 'modified-time' are property tagged subobjects under 'tunnel-svc' container. The 'avg-latency' and 'packet-loss' metrics are tagged subobjects under 'tunnel-svc' container node. Consider 'tunnel-svc' data object and tunnel-svc/name data object as an example, 'tunnel-svc' data object has one single object tag (i.e., 'ietf:object') while tunnel-svc/name data object has one single property subobject tag (i.e., 'ietf:property'). In addition, not all metric subobjects need to be tagged, e.g., only specific category such as loss-related metric subobjects need to be tagged with metric-type tag which can further reduce amount data to be fetched.

Data Object	Object Tag	Property Tag	Metric Tag	Module Name
tunnel-svc	ietf:object			tunnel-pm
tunnel-svc/name		ietf:property		tunnel-pm
tunnel-svc/create-time		ietf:property		tunnel-pm
tunnel-svc/modified-time		ietf:property		tunnel-pm
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 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.

4. Data Object Tag Values

All data object tags SHOULD begin with a prefix indicating who owns their definition. To that aim, an IANA registry ([Section 9.1](#)) is

used to support registering data object tag prefixes. Three prefixes are defined in the following subsections.

No further structure is imposed by this specification on the value following the registered prefix other than 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 any structure they may require to their own tag values.

4.1. 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 [Section 9.2](#).

4.2. 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 includes 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).

4.3. 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.

4.4. 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).

5. Data Object Tag Management

Tags may be associated with a data object within a YANG module in a number of ways. Typically, 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.

5.1. Module Design Tagging

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

opm-tag extension statement: Classifies management and operation data into object, property subobject, and metric subobject categories. Both object and subobjects can be modeled as YANG data nodes [RFC7950]. Data objects that contain other data objects can be one of 'container', 'leaf-list', and 'list' and are tagged with object tag. A subobject tagged with the property tag is a 'leaf' node. Subobjects tagged with the metric tag can be one of 'container', 'leaf-list', 'list', or 'leaf' data node. A data object contains one single object tag, one single property tag, or one single metric tag. A data object tagged with metric tag also can have one or multiple Metric type tag and/or one single multi-source tag. See the examples depicted in [Figure 2](#) and [Figure 3](#).

metric-type extension statement: Provides metric data objects classification (e.g., loss, jitter, delay, counter, gauge, summary, unknown) within the YANG module.

multi-source-tag extension statement: Identifies 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-type and multi-source-tag extension statements are context information that 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 ([Section 4.1](#)). Thus, new data object can drive the addition of new IETF tags to the IANA registry defined in [Section 9](#), and the IANA registry can serve as a check against duplication.

5.2. 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.

5.3. 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.

6. Data Object Tags Module Structure

6.1. Data Object Tags Module Tree

The tree associated with the "ietf-data-object-tags" module is as follows:

```
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
```

7. YANG Module

```
<CODE BEGINS> file "ietf-data-object-tags@2021-05-03.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:benoit.claise@huawei.com>
    Editor: Peng Liu <mailto:liupengyjy@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) 2021 IETF Trust and the persons identified as
    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 2021-05-03 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: Self Describing 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 object into object,
    property, and metric three categories. Data Object can contain
    other data objects called subobjects. Both object and subobjects
    can be modeled as data nodes. The Data Object tagged with object
    tag can be one of container, leaf-list and list. Data Object
    tagged with the Property tag is a leaf node. Data Object tagged with
    the Metric tag can be one of container, leaf-list, list, leaf.
    Data objects tagged with either property tag or metric tag are
    subobjects belonging to specific root data object. Each Data Object
    may contain One single object tag or one single property tag, or
    one single metric tag (These tags are mutually exclusive). As
    such the origin of the value for the pre-defined tags should be set
    to 'system'.";
}

```

```

extension metric-type {
  argument tag;
  description
    "The argument 'tag' is of type 'tag'. The metric type can be
    used to provide metric data object classification
    (e.g., loss, jitter, packet loss, counter, gauge,
    summary, unknown) 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 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 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>

8. Guidelines to Model Writers

This section updates [[RFC8407](#)].

8.1. 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 9.2](#).

9. IANA Considerations

9.1. YANG Data Object Tag Prefixes Registry

This document requests IANA to create a new registry entitled "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's 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.

9.2. IETF YANG Data Object Tags Registry

This document requests IANA to create three new registries "IETF OPM Tags", "IETF Metric Type 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.

Three registries are used to 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	Represents Root object containing other data objects (e.g., interfaces)	[This document]
ietf:property	Represents a property data object(e.g., ifindex) associated with a specific root object (e.g., interfaces)	[This document]
ietf:metric	Represent metric data object(e.g., ifstatistics) associated with specific root object(e.g., interfaces)	[This document]
Metric Type Tag	Description	Reference
ietf:delay	Represents the delay metric group to which the metric data objects belong to.	[This document]
ietf:jitter	Represents the jitter metric group to which the metric data objects belong to.	[This document]
ietf:loss	Represents the loss metric group to which the metric data objects belong to.	[This document]
ietf:counter	Represents any metric value associated with a metric data object that monotonically increases over time, starting from zero.	[This document]
ietf:gauge	Represents current measurements associated with a metric data object that may increase, decrease or stay constant.	[This document]
ietf:summary	Represents the metric value associated with a metric	[This document]

	data object that measures	
	distributions of discrete	
	events without knowing	
	predefined range.	
ietf:unknown	Represents the metric value [This	
	associated with metric document	
	data object that can not	
	determine the type of metric.	
+-----+-----+-----+		

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

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

9.3. Updates to the IETF XML Registry

This document requests IANA to register a new 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.

9.4. Updates to the YANG Module Names Registry

This document requests IANA to register 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
maintained by IANA: N

10. Security Considerations

The YANG module specified in this document defines schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [RFC8446].

The Network Configuration Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

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.

11. Acknowledgements

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12. Contributors

Liang Geng
China Mobile
32 Xuanwumen West St, Xicheng District
Beijing 10053

Email: gengliang@chinamobile.com

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13.1. Normative References

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Appendix A. NETCONF Example

The following is a 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 provided.

```
<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-dat
        <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:obj
          <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-dat
        <s:data-object>
          <s:object-name>/if:interfaces/if:interface/ip:ipv4</s:object-na
          <s:tag>ietf:object</s:tag>
        </s:data-object>
        <s:data-object>
          <s:object-name>/if:interfaces/if:interface/ip:ipv4/ip:enable</s
          <s:tag>ietf:property</s:tag>
        </s:data-object>
        <s:data-object>
          <s:object-name>/if:interfaces/if:interface/ip:ipv4/ip:mtu</s:obj
          <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@2021-05-03.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:benoit.claise@huawei.com>
    Editor: Peng Liu <mailto:liupengyjy@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.

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    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 2021-05-03 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: Self Describing 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'.";
}
extension metric-type {
    argument tag;
    description
        "The argument 'tag' is of type 'tag'.The metric-type can be
        used to provide metric subobject classification
        (e.g., loss, jitter, packet loss, guage, counter, histogram,
        unknow, etc.) 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 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 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 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.

```
+-----+                               +-----+
| Subscriber|                           | Publisher |
+-----+                               +-----+

|
|
| Telemetry data Tagging Advertisement
| (data object name, opm-tag = metric)
| <-----|
|
|     establish-subscription
| ----->|
|
|
|     RPC Reply: OK, id = 22
| <-----|
|
|
|     Notification Message (for 22)
| <-----|
|
|
```

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 corresponding telemetry data object capability model is created based on ietf-data-object-tags module defined in this document.

The following XML example [W3C.REC-xml-20081126] illustrates the advertisement 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-type>loss</sec:metric-type>
          </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. Alternatively, the subscriber can query data object tag list from somewhere(e.g., the network device, or offline document) using ietf-data-object-tags module defined in this document and fetch tagged data objects 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.

Appendix D. Changes between Revisions

v03 - v04

- *Remove histogram metric type tag from metric type tags.
- *Clarify the object tag and property tag, metric tag are mutual exclusive.
- *Clarify to have two optional node tags (i.e., object tag and property tag) to indicate relationship between data objects.
- *Update targeted data object collection example.

v02 - v03

- *Additional Editorial changes.
- *Security section enhancement.
- *Nits fixed.

v01 - v02

- *Clarify the relation between data object, object tag, property tag and metric tag in figure 1 and figure 2 and related description;

- *Change Metric Group into Metric Type in the YANG model;

- *Add 5 metric types in section 7.2;

v00 - v01

- *Merge self describing data object tag use case section into introduction section as a subsection;

- *Add one glossary section;

- *Clarify the relation between data object, object tag, property tag and metric tag in Self Describing Data Object Tags Use Case section;

- *Add update to RFC8407 in the front page.

Authors' Addresses

Qin Wu
Huawei
101 Software Avenue, Yuhua District
Nanjing
Jiangsu, 210012
China

Email: bill.wu@huawei.com

Benoit Claise
Huawei
De Kleetlaan 6a b1
1831 Diegem
Belgium

Email: benoit.claise@huawei.com

Peng Liu
China Mobile
32 Xuanwumen West St, Xicheng District
Beijing

Email: liupenggyjy@chinamobile.com

Zongpeng Du

China Mobile
32 Xuanwumen West St, Xicheng District
Beijing

Email: duzongpeng@chinamobile.com

Mohamed Boucadair
Orange
Rennes 35000
France

Email: mohamed.boucadair@orange.com