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A YANG Data Model for Network Diagnosis ~~by~~ using ~~Scheduling~~ Scheduled Sequences of OAM Tests

draft-contreras-opsawg-scheduling-oam-tests-02

Abstract

This document defines a YANG data model for on-demand network diagnosis ~~on-demand~~ relying upon ~~using~~ Operations, Administration, and Maintenance (OAM) tests.

This document defines both 'oam-unitary-test' and 'oam-test-sequence' ~~data models~~YANG modules to ~~enable~~ manage the activation of network diagnosis procedures.

About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at https://vlopezalvarez.github.io/draft-contreras-opsawg-scheduling-oam-tests/draft-contreras-opsawg-scheduling-oam-tests.html. Status information for this document may be found at https://datatracker.ietf.org/doc/draft-contreras-opsawg-scheduling-oam-tests/.

Discussion of this document takes place on the Operations and Management Area Working Group Working Group mailing list (mailto:opsawg@ietf.org), which is archived at https://mailarchive.ietf.org/arch/browse/opsawg/. Subscribe at https://www.ietf.org/mailman/listinfo/opsawg/.

Source for this draft and an issue tracker can be found at https://github.com/vlopezalvarez/draft-contreras-opsawg-scheduling-oam-tests.

Status of This Memo

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 9 January 2025.

Table of Contents

1. Introduction

Operations, Administration, and Maintenance (OAM) tasks are fundamental ~~functionalities~~ functions of the network management (see, e.g., [RFC7276]). Given the emerging of data models and their utilization in Service Provider's network management and the need ~~,~~ overall to automate the overall service management lifecycle [RFC8969], the management of OAM ~~tests~~ operations ~~represent also an area of~~

~~interest for operators, which~~is key. Relevant ~~requires to be defined as a~~ data model~~s~~ are still missing to cover specific needs.

Specifically, OAM ~~functionalities~~ functions provide the means to identify and isolate faults,

measure and report of performance. For example, [RFC5860] defines the three main

areas involved in OAM:

* Fault management, which allows network operators to quickly identify and isolate faults in the network. The OAM framework defines mechanisms for fault detection and isolation, such as continuity check, link trace, and loopback.

* Performance management enables monitoring network performance and diagnosing performance issues (i.e., degradation). Some of the measurements such as frame delay measurement, frame delay variation measurement, and frame loss measurement.

* Security management defines mechanisms to protect OAM communications from unauthorized access and tampering.

Also, [RFC6428] defines several use cases for OAM tools, including:

* Continuity Check: This function verifies that a path exists between two points in a network and that the path is operational.

* Loopback: This function allows a device to loop back a received packet back to the sender for diagnostic purposes.

* Link Trace: This function allows a network operator to trace a path through a network from one device to another.

* Performance Monitoring: This function allows a network operator to monitor the performance of a network and to identify and diagnose performance issues.

* Security Management: This function allows a network operator to protect OAM communications from unauthorized access and tampering.

* Configuration Management: This function allows a network operator to manage the configuration of network devices.

More recently, Incident Management [I-D.ietf-nmop-network-incident-yang] ~~also considers the possibility~~focuses on of incident diagnosis, which can be ~~favoured~~favored by dynamic invocation of OAM tests.

[RFC8531], [RFC8532,] and, [RFC8533] define~~d~~ YANG models for OAM technologies. ~~On the other hand,~~ [RFC8531] defines a YANG data model for connection-oriented OAM protocols. The main aim of [RFC8531] ~~this document~~ is to define a generic YANG data model that can be used to configure, control and monitor connection-oriented OAM protocols such as MPLS-TP OAM, PBB-TE OAM, and G.7713.1 OAM. [RFC8532] provides a generic YANG data model that can be used to configure, control and monitor connectionless OAM protocols such as BFD (Bidirectional Forwarding

Commenté [BMI1]: I would cite RFC 6632 - An Overview of the IETF Network Management Standards; section 4.2

Commenté [BMI2]: As the document is not specific to MPLS + the intent is not to be exhaustive here.

Commenté [BMI3]: Which framework?

Commenté [BMI4]: I would not used this ref as it is specific to MPLS-TP. I suggest you replace it with a more generic one, e.g., rfc7276#section-2.2

Commenté [BMI5]: To avoid confusion with your document

Detection), LBM (Loopback Messaging), and VCCV (Virtual Circuit Connectivity Verification). [RFC8533] provides specifies a YANG data model that can be used to retrieve information related to OAM protocols such as Bidirectional Forwarding Detection (BFD), Loopback Messaging (LBM,) and Virtual Circuit Connectivity Verification (VCCV).

[RFC8913] specifies a YANG data model for client and server implementations of the Two-Way Active Measurement Protocol (TWAMP).

Previous These RFCs defined the parameters required for each of the different tests that are used in network elements today. This document covers how to use OAM for network-wide use cases. Following, some illustrative examples are presented.

The YANG data model resulting from this document will conform to the Network Management Datastore Architecture (NMDA) [RFC8342].

Commenté [BMI6]: I understand this is provided as background, but I don't think the text is useful as it is. I would focus more one calling out what is missing and motivate your draft.

1.1. Terminology and Notations

This document assumes that the reader is familiar with the contents of [RFC7950], [RFC8345], [RFC8346], and [RFC8795].

Following terms are used for the representation of this data model:.

* OAM unitary test: it is aA set of parameters that define a type of OAM test to be invoked. As an example, it includes the type test, configuration parameters, and target results.

* OAM test sequence: it is aA set of OAM unitary tests that are run based on a set of time constraints, number of repetitions, order, and reporting outputs.

Tree diagrams used in this document follow the notation defined in [RFC8340].

1.2. Requirements Language

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 [RFC2119], [RFC8174] when, and only when, they appear in all capitals, as shown here.

1.3. Prefix in Data Node Names

In this document, names of data nodes and other data model objects will be prefixed using the standard prefix associated with the corresponding YANG imported modules, as shown in the following tableTable 1 lists the modules and prefixes used in this document.

Commenté [BMI7]: This is not specific to this document.

Prefix	Yang Module	Reference
oamut	ietf-oam-unitary-tests	RFCXXXX

oamts	ietf-oam-test-sequence	RFCXXXX
yang	ietf-yang-types	[RFC6991]

Table 1: Prefixes and Ceorresponding YANG ~~modules~~Modules

Commenté [BMI8]: Update the table with the common schedule module/prefix

RFC Editor Note: Please replace XXXX with the RFC number assigned to this document ~~if the document becomes a RFC~~. Please remove this note in that case.

2. Network-wide OAM Use Cases

2.1. Troubleshooting

After the detection of a problem in the network, OAM tests are performed to find the root cause for the detected ~~issue~~problem. However, a detected problem ~~detected~~ can be caused by a variety of factors, such as a misconfiguration, hardware failure, or ~~a~~ software bug. OAM tests can help to find the root cause by testing specific components of the network and looking for anomalies or issues. Also, the reliability and efficiency of the tests, depends on the nature of the test itself.

Commenté [BMI9]: Point to nmop terminology I-D.

There are a variety of ~~different~~ OAM tests that can be executed as a function of ~~depending on the nature of~~ the target scenario. For example, if the issue is related to a Layer 2 capability, specific tests can be designed and run to check the status of the path via Ethernet Linktrace and later run an Ethernet Loopback to a concrete network element. These tests can be coupled with others to test if any filtering is in place by varying, e.g., some Layer 2 fields or checking the configuration of relevant nodes. If these tests are correct, the operator may want to check the availability of the service (~~—~~or its delivered performance).

Even though the troubleshooting process may be different depending on the problem detected, there are certain common procedures or logics that can be executed in order to narrow down the cause of the problem and thus help isolating candidate root cause.

2.2. Birth Certificate

The aim of a birth certificate process is to validate that all relevant parameters are ~~correct~~ set appropriately in accordance with the target ~~for a specific~~ network service. The birth certificate process is done once the configuration of the network elements is completed and ~~they~~ are ready for service.

If the birth certificate is successful, it means that the network service is functioning correctly (that is, measured service is matching the expected service) and meets the requirements defined by the operator. The process requires running a set of OAM ~~tests~~ tasks (e.g., tests) to verify that the service is performing as expected.

The set of OAM tests ~~done~~ conducted as part of a birth certificate process
depends on the network service that is tested. For example, if the service is a V~~v~~irtual ~~private~~ Private N~~n~~etwork (VPN) Two-Way Active Measurement
Protocol (TWAMP) Light will be used, while if the service is an E-LINE, Ethernet CFM tests will be executed.

Typically, ~~Once~~ once the birth certificate process has been completed and the OAM
tests have been ~~run~~executed, the test results are stored as part of the
documentation process performed by the operator. Many of these tasks take place during pre-deployment phases.

2.3. Proactive Supervision

~~There are~~ Some ~~communication~~ network services ~~that~~ require to fulfill strict Service
Level Agreements (SLAs). An SLA~~s~~ defines the performance parameters that the
service must fulfill in order to meet the requirements of the
customer or end user (e.g., IP Connectivity Provisioning Profile (CPP) [RFC7297] and Network Slice Service [RFC9543]).~~.~~

As part of service fulfillment and assurance (e.g., Section 2.3.3 of [RFC4176)], Proactive verification are undertaken to ~~testing ensures~~ assess whether ~~the~~ SLAs are met and implement appropriate adjustment measures when service distortion is observed. ~~-~~Proactive supervision
requires running tests ~~on~~ both end-to-end, but also on service components to identify early symptoms and resolve
issues before they impact the customer or end user, or to prevent or minimize
the impact of the end user. Mitigation action may be enforced to soften the impact of networks incidents and soften/nullify the impact on services that are delivered via that network.

Proactive testing ~~can be~~might be done via OAM tests. These tests can be run
periodically at regular intervals depending on the specific SLA requirements and the network operator procedures. These procedures may require documenting the test results for future auditing
processes with the customers (eventually, negotiated and agreed with a customer as part of service assurance).

2.4. Performance-based Path Routing

Path Computation Elements (PCEs) ~~allow~~ are used to ~~computing~~ compute ~~end-to-end~~ paths in
a network. PCEs are used ~~to facilitate~~for T~~t~~raffic ~~engineering~~Engineering (TE) purposes (e.g., ~~and can be used to~~ optimize network performance, reduce congestion, and improve the overall user experience).

There are different algorithms to calculate a path in the network for some of them the PCE requires traffic engineering information. TE information includes data such as link metrics, bandwidth

Commenté [BMI10]: Consider adding references

Commenté [BMI11]: Please cite a reference

Commenté [BMI12]: A path is by definition between two ends :-)

Commenté [BMI13]: You may cite RFC 9522

availability, and routing constraints. By using this information, the PCE can compute the optimal path for a particular service, taking into account its constraints and requirements. OAM techniques allow obtaining link metrics like delay and loss which can be used in the PCE algorithms.

3. Modelling the Scheduling of OAM Tests

This document ~~proposes~~ specifies two models: OAM unitary test and OAM test sequence models.

3.1. OAM Unitary Test

The OAM unitary test model encompasses parameters that define a specific type of OAM test to be performed. The YANG model includes a container named "oam-unitary-tests" that serves as a container for activating OAM unitary tests for network diagnosis procedures. Inside the container, there is a list called "oam-unitary-test" representing a list of specific OAM unitary tests.

The list key is defined as "name", which provides a unique name for each test. Each OAM test in the list references a test type with its concrete parameters.

The test types are out of the scope of this document.

Moreover, each OAM unitary test has two temporal parameters: "period-of-time" and "recurrence". Both are imported from the "ietf-schedule" module from [I-D.ietf-netmod-schedule-yang]. "period-of-time" identifies the period values that contain a precise period of time, while "recurrence" identifies the properties that contain a recurrence rule specification. "unitary-test-status" enumerates the state of the OAM unitary test.

Figure 1 ~~contains~~ shows the structure of this module~~the tree of the proposed model.~~ ~~Tree diagrams used in this document follow the notation defined in [RFC8340].~~

```
module: ietf-oam-unitary-test
  +--rw oam-unitary-tests
     +--rw oam-unitary-test* [name]
        +--rw name                          string
        +--rw (test-type)
        +--rw period-description?           string
        +--rw period-start                  yang:date-and-time
        +--rw time-zone-identifier?         sys:timezone-name
        +--rw (period-type)?
        |  +--:(explicit)
        |  |  +--rw period-end?             yang:date-and-time
        |  +--:(duration)
        |     +--rw duration?               duration
        +--rw recurrence-description?       string
        +--rw frequency                     identityref
        +--rw interval?                     uint32
        +--rw unitary-test-status?          enumeration
```

Commenté [BMI14]: The common module includes state information that can be useful here. Please consider those

a mis en forme : Surlignage

Figure 1: Tree Structure of OAM ~~unitary~~ Unitary Ttest

The 'unitary-test-status' state machine is shown in Figure 2. The state machine includes the following states:

* "planned": The initial state where the test is planned.

* "configured": The state where the test is being configured.

* "ready": The state where the test is ready to be executed.

* "on-going": The state where the test is currently running.

* "stop": The state where the test is manually stopped.

* "error": The state where an error occurs during the test.

* "finished": The final state where the test is completed.

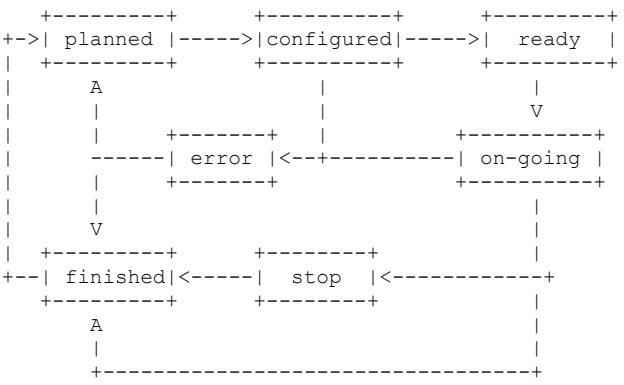

Figure 2: OAM Uunitary ~~test~~ Test ~~state~~ State Mmachine

3.2. OAM Test Sequence

The OAM test sequence model consists of a collection of OAM unitary tests that are executed based on specified time constraints, repetitions, ordering, and reporting outputs. These sequences provide a structured approach to running multiple OAM tests in a coordinated manner.

Each OAM test sequence references ~~a~~ an OAM unitary test type with its concrete parameters. Each OAM test sequence has two temporal parameters: "period-of-time" and "recurrence". Both are imported from the "ietf-schedule" module from [I-D.ietf-netmod-schedule-yang]. "period-of-time" identifies the period values that contain a precise period of time, while "recurrence" identifies the properties that contain a recurrence rule specification. "unitary-test-status" enumerates the state of the OAM test. Finally, "test-sequence-status" shows the state of the OAM test sequence.

Commenté [BMI15]: I guess this is an example of state machine.

Other state may be considered such as "configured but not enabled", "configured and enabled", "configuration-ready", etc.

~~An example of the proposed structure~~ Figure 3 shows the tree structure of this module.

```
module: ietf-oam-test-sequence
  +--rw oam-test-sequence
     +--rw test-sequence* [name]
        +--rw name                          string
        +--rw test-ref* [name]
        |  +--rw name                 string
        |  +--rw (test-type)
        |  +--rw numexecutions?   uint32
        +--rw period-description?       string
        +--rw period-start              yang:date-and-time
        +--rw time-zone-identifier?     sys:timezone-name
        +--rw (period-type)?
        |  +--:(explicit)
        |  |  +--rw period-end?         yang:date-and-time
        |  +--:(duration)
        |     +--rw duration?           duration
        +--rw recurrence-first
        |  +--rw utc-start-time?   yang:date-and-time
        |  +--rw duration?         uint32
        +--rw (recurrence-bound)?
        |  +--:(until)
        |  |  +--rw utc-until?          yang:date-and-time
        |  +--:(count)
        |     +--rw count?              uint32
        +--rw recurrence-description?   string
        +--rw frequency                 identityref
        +--rw interval?                 uint32
        +--rw test-sequence-status?     enumeration
```

Figure 3: Tree Structure of OAM T~~t~~est ~~sequence~~sequence

The 'test-sequence-status' state machine is shown in Figure 4. The state machine includes the following states:

* "planned": The initial state where the test is planned.

* "configured": The state where the test is being configured.

* "ready": The state where the test is ready to be executed.

* "on-going": The state where the test is currently running.

* "stop": The state where the test is manually stopped.

* "success": The success state when all unitary tests were successful.

* "failure": The success state when One or more tests in the sequence got an error.

* "error": The state where an error occurs during the test.

```
+---------+      +----------+      +---------+
```

a mis en forme : Surlignage

Commenté [BMI16]: Is it intended to use the utc grouping but the one with zone identifier for the periods?

Commenté [BMI17]: Given my comment above, I would use identities here

Commenté [BMI18]: It seems this is similar to the FSM provided earlier in the doc.

Any reason to duplicate this?

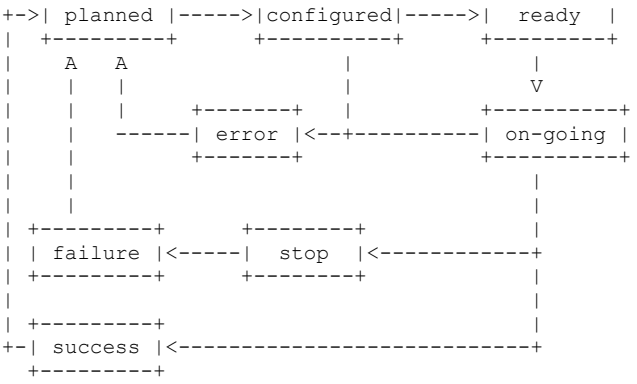

Figure 4: OAM unitary test state machine

4. YANG Data Models for Scheduling OAM Tests

4.1. YANG Models Overview

This document proposes two models: OAM unitary test and OAM test sequence. OAM unitary test is a set of parameters that define a type of OAM test to be invoked. As an example, it includes the type test, configuration parameters, and target results. The OAM test sequences are a set of OAM unitary tests that are run based on a set of time constraints, number of repetitions, order, and reporting outputs.

4.2. YANG Model for Scheduling OAM Unitary Test

This module uses types defined in XXX.

Commenté [BMI19]: Please complete with relevant pointers

```
<CODE BEGINS>
 file ietf-oam-unitary-test@2024-07-05.yang
module ietf-oam-unitary-test {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-oam-unitary-test";
  prefix "oamut";

  // Import OAM models from RFCs RFC8531, RFC8532 and RFC8533

  // reference ietf-netmod-schedule-yang

  import ietf-schedule { prefix "schedule"; }

  organization
    "IETF OPSAWG (Operations and Management Area Working Group)";

  contact
    "WG Web:   <https://datatracker.ietf.org/wg/opsawg/>
     WG List:  <mailto:opsawg@ietf.org>
     Author: Luis Miguel Contreras Murillo
          <luismiguel.contrerasmurillo@telefonica.com>
     Author: Victor Lopez
          <victor.lopez@nokia.com>";
```

Commenté [BMI20]: There are no such imports

```
      description
        "This module defines the 'ietf-oam-unitary-test' YANG model for
         activation management of network diagnosis procedures.

        Copyright (c) 2024 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 Revised 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://www.rfc-editor.org/info/rfcXXXX); see the RFC itself
         for full legal notices.";

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

      revision "2024-07-05" {
        description
          "Initial version";
        reference
          "RFCXXXX: A YANG Data Model for Network Diagnosis by Scheduling
                    Sequences of OAM Tests";
          // Update with the correct RFC number when assigned
      }

      grouping oam-unitary-test {
        description
            "This Specifies a grouping is defined for OAM unitary test for
network
             diagnosis procedures.";

        leaf name {
          type string;
          description
            "Defines the Name name for of the test.";
        }

        choice test-type {
          mandatory true;
          description
            "Choose the type of test.";
            // Import OAM models from RFCs RFC8531, RFC8532 and RFC8533
        }
      }

      container oam-unitary-tests {
        description
          "Container for OAM unitary tests activation for network
          diagnosis procedures.";

        list oam-unitary-test {
```

Commenté [BMI21]: This is only a subset of operations

Commenté [BMI22]: You already have a note about this early in the document

Commenté [BMI23]: I guess the intent here is to include a reference to a test specification.

```
        key name;
        description
          "List of OAM unitary tests activation for network diagnosis
          procedures.";

        uses oam-unitary-test;

        uses schedule:period-of-time;

        uses schedule:recurrence;

        leaf unitary-test-status {
          type enumeration {
            enum "planned" {
              description
                "The test is planned.";
            }
            enum "configure" {
              description
                "The test is configured.";
            }
            enum "ready" {
              description
                "The test status is ready.";
            }
            enum "ongoing" {
              description
                "The test is ongoing.";
            }
            enum "stop" {
              description
                "The test is stopped.";
            }
            enum "finish" {
              description
                "The test is finished.";
            }
            enum "error" {
              description
                "The test has an error.";
            }
          }
          description
            "Status of the test.";
        }
      }
    }
  }
  <CODE ENDS>
```

Commenté [BMI24]: See my comment about identities

4.3. YANG Model for OAM Test Sequence

```
  <CODE BEGINS>
   file ietf-oam-test-sequence@2024-07-05.yang

  module ietf-oam-test-sequence {
    yang-version 1.1;
    namespace "urn:ietf:params:xml:ns:yang:ietf-oam-test-sequence";
```

```
  prefix "oamts";

  import ietf-oam-unitary-test {
    prefix "oamut";
    // Update the reference with the correct RFC number or other
    // reference when assigned
    reference "RFCXXXX";
  }

  // reference ietf-netmod-schedule-yang
  import ietf-schedule { prefix "schedule"; }

  organization
    "IETF OPSAWG (Operations and Management Area Working Group)";

  contact
    "WG Web:   <https://datatracker.ietf.org/wg/opsawg/>
     WG List:  <mailto:opsawg@ietf.org>

     Author: Luis Miguel Contreras Murillo
          <luismiguel.contrerasmurillo@telefonica.com>
     Author: Victor Lopez
          <victor.lopez@nokia.com>";
  description
    "This module defines the 'oam-unitary-test' YANG model for
    activation of network diagnosis procedures.

    Copyright (c) 2024 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 Revised 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://www.rfc-editor.org/info/rfcXXXX); see the RFC itself
     for full legal notices.";

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

  revision "2024-07-05" {
    description "Initial version";
    reference "RFC XXXX: …";
    // Update with the correct RFC number when assigned
  }

  // Data model definition

  container oam-test-sequence {
    description
      "Container for executing a sequence of ietf-oam-unitary-tests
      N times.";
```

```
list test-sequence {
  key "name";
  description "List of test sequences.";

  leaf name {
    type string;
    description "Unique name for the test sequence.";
  }
  list test-ref {
    key "name";
    description "References to the ietf-oam-unitary-tests.";

    uses "oamut:oam-unitary-test";

    leaf numexecutions {
      type uint32;
      default 1;
      description
        "Number of times the test sequence should be
        executed.";
    }
  }

  uses schedule:period-of-time;

  uses schedule:recurrence-utc;

  leaf test-sequence-status {
    type enumeration {
      enum "planned" {
        description
          "The test sequence is planned.";
      }
      enum "configured" {
        description
          "The test sequence is configured.";
      }
      enum "ready" {
        description
          "The test sequence is ready.";
      }
      enum "ongoing" {
        description
          "The test sequence status is ongoing.";
      }
      enum "stop" {
        description
          "The test sequenceis stopped.";
      }
      enum "success" {
        description
          "All tests in the sequence were successful.";
      }
      enum "failure" {
        description
          "One or more tests in the sequence got an error.";
      }
```

Commenté [BMI25]: The same time as the unitary can be used.

```
            enum "error" {
              description
                "The test sequence status has an error.";
            }
          }

          description
            "Status of the test sequence execution.";
        }
      }
    }
  }
  <CODE ENDS>
```

5. Using Device Mode Within OAM Scheduling Models

This section discusses the ~~problematic~~ issues related to ~~of~~ reusing device models already defined in IETF within the context of scheduling OAM tests.

There are two main approaches to enable OAM scheduling models:

* Importing YANG model into the OAM scheduling models. This approach will copy the device model into the OAM unitary test model to enable the configuration and utilization of the desire OAM test. This approach requires to recreate new YANG models for each new test type or variation of the device models.

* Schema-mount allows mounting a data model at a specified location of another (parent) schema. The main difference with importing the YANG modules is that they don't have to be prepared for mounting; any existing modules such as "ietf-twamp" can be mounted without any modifications.

As an exmaple, we will use [RFC8913], which defines a YANG data model for TWAMP, to illustrate how device models could be used.

6. Security Considerations

The YANG module targeted in this document defines a 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 [RFC5246].

The NETCONF access control model [RFC6536] 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.

There are a number of data nodes defined in this YANG module that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative

effect on network operations.

In which refers to the scheduling of the tests, security considerations in [I-D.ietf-netmod-schedule-yang] are also applicable here.

7. IANA Considerations

TBC

8. Implementation Status

This section will be used to track the status of the implementations of the model. It is aimed at being removed if the document becomes RFC.

9. Normative References

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