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New YANG Module Update Procedure
draft-clacla-netmod-yang-model-update-06

Abstract

This document specifies a new YANG module update procedure in case of backward-incompatible changes, as an alternative proposal to the YANG 1.1 specifications. This document updates RFC 7950.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on January 3, 2019.

Table of Contents

1. Introduction

This document puts forth a solution to the problems described in [I-D.verdt-netmod-yang-versioning-reqs] by proposing changes to [RFC7950] to address the various requirements that [I-D.verdt-netmod-yang-versioning-reqs] specifies. At this time, the solution herein addresses requirements 1.1, 1.2, 1.3, 2.1, 4.1, 4.2, 4.3, 5.1, and 5.2. Current gaps are documented in Appendix A.1 below.

2. The Solution

The solution is composed of five parts:

1. A semantic versioning YANG extension, along with an optional additional check that validates the semantic versioning from a syntactic point of view, which can either assist in determining the correct semantic versioning value, or which can help in

determining the values for YANG modules that do not support this extension.

2. An import by semantic version statement

3. Updates to the YANG 1.1 module update rules

4. Updates to ietf-yang-library

5. An introduction of deprecated and obsolote reason clauses

2.1. Semantic Versioning

2.1.1. Semantic Versioning, As Set by the YANG Module Designer

The semantic versioning solution proposed here has already been proposed in [I-D.openconfig-netmod-model-catalog] (included here with the authors' permission) which itself is based on [openconfigsemver]. The goal is to indicate the YANG module backward (in)compatibility, following semver.org semantic versioning [semver]:

"The SEMVER version number for the module is introduced. This is expressed as a semantic version number of the form: x.y.z

- x is the MAJOR version. It is incremented when the new version of the specification is incompatible with previous versions.

- y is the MINOR version. It is incremented when new functionality is added in a manner that is backward-compatible with previous versions.

- z is the PATCH version. It is incremented when bug fixes are made in a backward-compatible manner."

The semantic version value is set by the YANG module developer at the design and implementation times. Along these lines, we propose the following YANG 1.1 extension for a more generic semantic version. The formal definition is found at the end of this document. This semantic version extension and the text below address requirements 1.1, 1.2, 2.1, 5.1 and 5.2 of [I-D.verdt-netmod-yang-versioning-reqs].

```
extension module-version {
    argument semver;
}
```

The extension would typically be used this way:

```
module yang-module-name {

  namespace "name-space";
  prefix "prefix-name";

  import ietf-semver { prefix "semver"; }

  description
    "to be completed";


  revision 2017-10-30 {
    description
      "Change the module structure";
    semver:module-version "2.0.0";
  }

  revision 2017-07-30 {
    description
      "Added new feature XXX";
    semver:module-version "1.2.0";
  }

  revision 2017-04-03 {
    description
      "Update copyright notice.";
    semver:module-version "1.0.1";
  }

  revision 2017-04-03 {
    description
      "First release version.";
    semver:module-version "1.0.0";
  }

  revision 2017-01-26 {
    description
      "Initial module for inet types";
    semver:module-version "0.1.0";
  }


  //YANG module definition starts here
```

See also "Semantic Versioning and Structure for IETF Specifications" [I-D.claise-semver] for a mechanism to combine the semantic versioning, the GitHub tools, and a potential change to the IETF process.

2.1.2. The Derived Semantic Version

If an explicitly defined semantic version is not available in the YANG module, it is possible to algoritmically calculate a derived semantic version. This can be used for modules not containing a definitive semantic-version as defined in this document or as a starting value when specifying the definitive semantic-version. Be aware that this algorithm may sometimes incorrectly classify changes between the categories non-compatible, compatible or error-correction.

2.1.3. Implementation Experience

[yangcatalog] uses the pyang utility to calculate the derived-semantic-version for all of the modules contained within the catalog. [yangcatalog] contains many revisions of the same module in order to provide its derived-semantic-version for module consumers to know what has changed between revisions of the same module.

Two distinct leafs in the YANG module [I-D.clacla-netmod-model-catalog] contain this semver notation:

- the semantic-version leaf contains the value embedded within a YANG module (if it is available).

- the derived-semantic-version leaf is established by examining the the YANG module themselves. As such derived-semantic-version only takes syntax into account as opposed to the meaning of various elements when it computes the semantic version.

- The algorithm used to produce the derived-semantic-version is as follows:

  1. Order all modules of the same name by revision from oldest to newest. Include module revisions that are not available, but which are defined in the revision statements in one of the available module versions.

  2. If module A, revision N+1 has failed compilation, bump its derived semantic MAJOR version. For unavailable module versions assume non-backward compatible changes were done., thus bump its derived semantic MAJOR version.

  3. Else, run "pyang --check-update-from" on module A, revision N and revision N+1 to see if backward-incompatible changes exist.

4. If backward-incompatible changes exist, bump module A, revision N+1's derived MAJOR semantic version.

5. If no backward-incompatible changes exist, compare the pyang trees of module A, revision N and revision N+1.

6. If there are structural differences (e.g., new nodes), bump module A, revision N+1's derived MINOR semantic version.

7. If no structural differences exist, bump module A, revision N+1's derived PATCH semantic version.

The pyang utility checks many of the points listed in section 11 of [RFC7950] for known module incompatibilities. While this approach is a good way to programmatically obtain a semantic version number, it does not address all cases whereby a major version number might need to be increased. For example, a node may have the same name and same type, but its meaning may change from one revision of a module to another. This represents a semantic change that breaks backward compatibility, but the above algorithm would not find it. Therefore, additional, sometimes manual, rigor must be done to ensure a proper version is chosen for a given module revision.

2.2. Import by Semantic Version

If a module is imported by another one, it is usually not specified which revision of the imported module should be used. However, not all revisions may be acceptable. Today YANG 1.1 allows one to specify the revision date of the imported module, but that is too specific, as even a small spelling correction of the imported module results in a change to its revision date, thus making the module revision ineligible for import.

Using semantic versioning to indicate the acceptable imported module versions is much more flexible. For example:

- Only a module of a specific MAJOR version is acceptable. All MINOR and PATCH versions can also be imported.

- A module at a specific MAJOR version or higher is acceptable.

- A module at a specific MAJOR.MINOR version is acceptable. All PATCH versions can also be imported.

- A module within a certain range of versions are acceptable. For example, in this case, a module between version 1.0.0 (inclusive) and 3.0.0 (exclusive) are acceptable.

The ietf-semver module provides another extension, import-versions that is a child of import and specifies the rules for an acceptable set of versions of the given module. This extension addresses requirement 1.3 of [I-D.verdt-netmod-yang-versioning-reqs]. The structure of this extension is specified as follows:

TODO: How to specify this? One thought is below, not fully formalized as this should be discussed further. Note: while this uses a comma to separate discrete versions, we could instead allow for this to be specified multiple times.

[\[(]X[.Y[.Z]][-[X[.Y[.X]]][\])]][,...]

Where the first character MAY be a '[' or '(' to indicate at least inclusive and at least
exclusive (respectively). If this is omitted, a full semantic version must be specified
and the import will only support this one version.

The following version, if specified with a '[' or '(' indicates the lower bound. This can
be a full semantic version or a MAJOR only or MAJOR.MINOR only.

The '-', if specified, is a literal hyphen indicating a range will be specified. If the second portion
of the import-versions clause is omitted, then there is no upper bound on what will be considered
an acceptable imported version.

After the '-' the upper bound semantic version (or part thereof) follows.

After the upper bound version, one of ']' or ')' MUST follow to indicate whether this limit is inclusive
or exclusive of the upper bound respectively.

Finally, a literal comma (',') MAY be specified with additional ranges. Each range is taken as a logical
OR.

For example:

```
import example-module {
  semver:import-versions "[1.0.0-3.0.0)";
  // All versions between 1.0.0 (inclusive) and 3.0.0 (exclusive) are
acceptable.
}

import example-module {
  semver:import-versions "[2-5]";
  // All versions between 2.0.0 (inclusive) and 5.y.z (inclusive) where y and z
are
  // any value for MINOR and PATCH versions.
}

import example-module {
  semver:import-versions "[1.5-2.0.0),[2.5";
  // All versions between 1.5.0 (inclusive) and 2.0.0 (exclusive) as well as
all versions
  // greater than 2.5 (inclusive).  In this manner, if 2.0 was branched from
1.4, and a
  // new feature was added into 1.5, all versions of 1.x.x starting at 1.5 are
allowed,
  // but the feature was not merged into 2.y.z until 2.5.0.
}

import example-module {
  semver:import-versions "[1";
  // All versions greater than MAJOR version 1 are acceptable.  This includes
any
  // MINOR or PATCH versions.
}

import example-module {
  semver:import-versions "1.0.0";
  // Only version 1.0.0 is acceptable (this mimics what exists with import by
revision).
}

import example-module {
  semver:import-versions "[1.1-2)"";
  // All versions greater than 1.1 (inclusive, and including all PATCH versions
off of 1.1)
  // up to MAJOR version 2 (exclusive) are acceptable.
}

import example-module {
  semver:import-versions "[1.1-2),[3";
  // All versions greater than 1.1 (inclusive, and including all PATCH versions
off of 1.1)
```

```
  // up to MAJOR version 2 (exclusive), as well as all versions greater than
MAJOR version 3
  // (inclusive) are acceptable.
}

import example-module {
  semver:import-versions "[1.1-2),[3.0.0";
  // This is equivalent to the example above, simply indicating that a partial
semantic version
  // assumes all missing components are 0.
}
```

The import statement SHOULD include a semver:import-versions statement and MUST NOT include a revision statement. An import statement MUST NOT contain both a semver:import-versions and a revision substatement. The use of the revision substatement for import should be discouraged.

2.3. Updates to YANG 1.1 Module Update Rules

RFC 7950 section 11, must be updated to allow for non-backward changes provided they follow the semantic versioning guidelines and increase the MAJOR version number when a backward incompatible change is made. This change is in the spirit of requirement 5.1 from [I-D.verdt-netmod-yang-versioning-reqs]. The following is proposed text for this change.

"As experience is gained with a module, it may be desirable to revise that module. Changes to published modules are allowed, even if they have some potential to cause interoperability problems, if the module-version YANG extension is used in the revision statement to clearly indicate the nature of the change."

2.4. Updates to ietf-yang-library

The ietf-semver YANG module also specifies additional ietf-yang-library [RFC7895] [I-D.ietf-netconf-rfc7895bis] leafs to be added at the module and submodule levels. The first is module-version, which augments /yanglib:yang-library/yanglib:module-set/yanglib:module. This specifies the current semantic version of the associated module and revision in a given module-set. The related submodule-version leaf is added at /yanglib:yang-library/yanglib:module-set/yanglib:module/yanglib:submodule to indicate the semantic version of a submodule.

In order to satisfy the requirements 4.1 and 4.3 of [I-D.verdt-netmod-yang-versioning-reqs] that deprecated and obsolete node presence and operation are easily and clearly known to clients, ietf-semver also augments the ietf-yang-library with two additional boolean leafs at /yanglib:yang-library/yanglib:module-set/yanglib:module. A client can make one request of the ietf-yang-library and know whether or a not a module that has deprecated or obsolete has those nodes implemented by the server, as opposed to making multiple requests for each node in question.

deprecated-nodes-present : A boolean that indicates whether or not this server implements deprecated nodes. The value of this leaf SHOULD be true; and if so, the server MUST implement nodes within this module as they are documented. If specific deprecated nodes

are not implemented as documented, then they MUST be listed as deviations. This leaf defaults to true.

obsolete-nodes-present : A boolean that indicates whether or not this server implements obsolete nodes. The value of this leaf SHOULD be false; and if so, the server MUST NOT implement nodes within this module. If this leaf is true, then all nodes in this module MUST be implemented as documented in the module. Any variation of this MUST be listed as deviations. This leaf defaults to false.

If a module does not have any deprecated or obsolete nodes, the server SHOULD set the corresponding leaf above to true. This is helpful to clients, such that if the MAJOR version number has not changed, and these booleans are true, then a client does not have to check the status of any node for the module.

Module compatibility can be affected if values other than the default are used for the leafs described here. For example, if a server does not implemennt deprecated nodes, then a given module revision may be incompatible with a previous revision where the nodes were not deprecated. When calculating backward compatibility, the default values of these leafs MUST be considered. From a client's point of view, if two module revisions have the same MAJOR version but the run-time value of deprecated-nodes-present (as read from the ietf-yang-library) is false, then compatibility MUST NOT be assumed based on the module-version alone.

2.5. Deprecated and Obsolete Reasons

The ietf-semver module specifies an extension, status-description, that is designed to be used as a substatement of the status statement when the status is deprecated or obsolete. The argument to this extension is freeform text that explains why the node was deprecated or made obsolete. It may also point to other schema elements that take the place of the deprecated or obsolete node. This text is designed for human consumption to aid in the migration away from nodes that will one day no longer work. These extensions address requirement 4.2 of [I-D.verdt-netmod-yang-versioning-reqs]. An example is shown below.

```
   leaf imperial-temperature {
     type int64;
     units "degrees Fahrenheit";
     status deprecated {
       semver:status-description
         "Imperial measurements are being phased out in favor
          of their metric equivalents.  Use metric-temperature
          instead.";
     }
     description
       "Temperature in degrees Fahrenheit.";
   }
```

3. Semantic Version Extension YANG Module

The extension and related ietf-yang-library changes described in this module are defined in the YANG module below.

```
<CODE BEGINS> file "ietf-semver@2018-04-05.yang"
  module ietf-semver {
    yang-version 1.1;
    namespace "urn:ietf:params:xml:ns:yang:ietf-semver";
    prefix semver;

    import ietf-yang-library {
      prefix yanglib;
    }

    organization
      "IETF NETMOD (Network Modeling) Working Group";
    contact
      "WG Web:   <https://datatracker.ietf.org/wg/netmod/>
       WG List:  <mailto:netmod@ietf.org>

       Author:   Benoit Claise
                 <mailto:bclaise@cisco.com>

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       Author:   Kevin D'Souza
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       Author:   Balazs Lengyel
                 <mailto:balazs.lengyel@ericsson.com>";
    description
      "This module contains a definition for a YANG 1.1 extension to
       express the semantic version of YANG modules.";
```

```
    revision 2018-04-05 {
      description
        "* Properly import ietf-yang-library.
         * Fix the name of module-semver => module-version.
         * Fix regular expression syntax.
         * Augment yang-library with booleans as to whether or not
           deprecated and obsolete nodes are present.
         * Add an extension to enable import by semantic version.
         * Add an extension status-description to track deprecated
           and obsolete reasons.
         * Fix yang-library augments to use 7895bis.";
      reference
        "draft-clacla-netmod-yang-model-update:
         New YANG Module Update Procedure";
      semver:module-version "0.2.1";
    }
    revision 2017-12-15 {
      description
        "Initial revision.";
      reference
        "draft-clacla-netmod-yang-model-update:
         New YANG Module Update Procedure";
      semver:module-version "0.1.1";
    }

    extension module-version {
      argument semver;
      description
        "The version number for the module revision it is used in.
         This is expressed as a semantic version string in the form:
          x.y.z
         where:
          * x corresponds to the major version,
          * y corresponds to a minor version,
          * z corresponds to a patch version.

         A major version number of 0 indicates that this model is still
         in development, and is potentially subject to change.

         Following a release of major version 1, all modules will
         increment major revision number where backward incompatible
         changes to the model are made.

         The minor version is changed when features are added to the
         model that do not impact current clients use of the model.
         When major version is stepped, the minor version is reset to 0.

         The patch-level version is incremented when non-feature changes
```

```
         (such as bugfixes or clarifications to human-readable
         descriptions that do not impact model functionality) are made
         that maintain backward compatibility.
         When major or minor version is stepped, the patch-level is
         reset to 0.

         By comparing the module-version between two revisions of a
         given module, one can know if different revisions are backward
         compatible or not, as well as
         whether or not new features have been added to a newer revision.

         If a module contains this extension it indicates that for this
         module the updated status and update rules as this described in
         RFC XXXX are used.

         The statement MUST only be a substatement of the revision statement.
         Zero or one module-version statement is allowed per parent
         statement. NO substatements are allowed.
       ";
     reference "http://semver.org/ : Semantic Versioning 2.0.0";
   }

   extension import-versions {
     argument version-clause;
     description
       "This extension specifies an acceptable set of semantic versions of a
given module
        that may be imported.  The version-clause argument is specified in the
following
        format

        [\\[(]X[.Y[.Z]][-[X[.Y[.X]]][\\])]][,...]

        Where the first character MAY be a '[' or '(' to indicate at least
inclusive and at least
         exclusive (respectively).  If this is omitted, a full semantic
version must be specified
         and the import will only support this one version.

        The following version, if specified with a '[' or '(' indicates the
lower bound.  This can
         be a full semantic version or a MAJOR only or MAJOR.MINOR only.

        The '-', if specified, is a literal hyphen indicating a range will be
specified.  If the second portion
         of the import-versions clause is omitted, then there is no upper
bound on what will be considered
         an acceptable imported version.
```

After the '-' the upper bound semantic version (or part thereof) follows.

After the upper bound version, one of ']' or ')' MUST follow to indicate whether this limit is inclusive or exclusive of the upper bound respectively.

Finally, a literal comma (',') MAY be specified with additional ranges. Each range is taken as a logical OR.

```
         The statement MUST only be a substatement of the import statement.
Zero or one
         import-versions statement is allowed per import statement.  NO
substatements are allowed.";
      reference "I-D.clacla-netmod-yang-model-update : Import By Semantic
Version";
    }

    extension status-description {
      argument description;
      description
        "Freeform text that describes why a given node has been deprecated or
made obsolete.
         This may point to other schema elements that can be used in lieu of
the given node.

         This statement MUST only be used as a substatement of the status
statement, and MUST
         only be used when the status is deprecated or obsolete.  Zero or more
status-description
         statements are allowed per parent statement.  NO substatements are
allowed.";
      reference "I-D.clacla-netmod-yang-model-update : Deprecated and Obsolete
Reasons";
    }

    augment "/yanglib:yang-library/yanglib:module-set/yanglib:module" {
      description
        "Augmentations for the ietf-yang-library module to support semantic
versioning.";
      leaf module-version {
        type string {
          pattern '[0-9]+\.[0-9]+\.[0-9]+';
        }
        description
          "The semantic version for this module in MAJOR.MINOR.PATCH format.
This version
           must match the semver:module-version value in specific revision of
the module
           loaded in this module-set.";
      }
      leaf deprecated-nodes-present {
        type boolean;
        default "true";
        description
          "A boolean that indicates whether or not this server implements
deprecated nodes.
           The value of this leaf SHOULD be true; and if so, the server MUST
```

```
implement nodes
           within this module as they are documented.  If specific deprecated
nodes are not
           implemented as document, then they MUST be listed as deviations.  If
a module does
           not currently contain any deprecated nodes, then this leaf SHOULD be
set to true.";
      }
      leaf obsolete-nodes-present {
        type boolean;
        default "false";
        description
          "A boolean that indicates whether or not this server implements
obsolete nodes.
           The value of this leaf SHOULD be false; and if so, the server MUST
NOT implement
           nodes within this module. If this leaf is true, then all nodes in
this module MUST
           be implemented as documented in the module.  Any variation of this
MUST be listed as
           deviations.  If a module does not currently contain any obsolete
nodes, then this
```

```
           leaf SHOULD be set to true.";
      }
    }
    augment "/yanglib:yang-library/yanglib:module-set/yanglib:module/
yanglib:submodule" {
      description
        "Augmentations for the ietf-yang-library module/submodule to support
semantic versioning.";
      leaf submodule-version {
        type string {
          pattern '[0-9]+\.[0-9]+\.[0-9]+';
        }
        description
          "The semantic version for this submodule in MAJOR.MINOR.PATCH
format.  This version
           must match the semver:module-version value in specific revision of
the submodule
           loaded in this module-set.";
      }
    }
  }
<CODE ENDS>
```

4. Contributors

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5. Security Considerations

The document does not define any new protocol or data model. There are no security impacts.

6. IANA Considerations

6.1. YANG Module Registrations

The following YANG module is requested to be registred in the "IANA Module Names" registry:

The ietf-semver module:

- Name: ietf-semver
- XML Namespace: urn:ietf:params:xml:ns:yang:ietf-semver
- Prefix: semver

- Reference: [RFCXXXX]

7. References

7.1. Normative References

[I-D.verdt-netmod-yang-versioning-reqs]
Clarke, J., "YANG Module Versioning Requirements", draft-verdt-netmod-yang-versioning-reqs-00 (work in progress), July 2018.

[RFC7895] Bierman, A., Bjorklund, M., and K. Watsen, "YANG Module Library", RFC 7895, DOI 10.17487/RFC7895, June 2016, <https://www.rfc-editor.org/info/rfc7895>.

[RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", RFC 7950, DOI 10.17487/RFC7950, August 2016, <https://www.rfc-editor.org/info/rfc7950>.

7.2. Informative References

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[I-D.claise-semver]
Claise, B., Barnes, R., and J. Clarke, "Semantic Versioning and Structure for IETF Specifications", draft-claise-semver-02 (work in progress), January 2018.

[I-D.ietf-netconf-rfc7895bis]
Bierman, A., Bjorklund, M., Schoenwaelder, J., Watsen, K., and R. Wilton, "YANG Library", draft-ietf-netconf-rfc7895bis-06 (work in progress), April 2018.

[I-D.openconfig-netmod-model-catalog]
Shaikh, A., Shakir, R., and K. D'Souza, "Catalog and registry for YANG models", draft-openconfig-netmod-model-catalog-02 (work in progress), March 2017.

[openconfigsemver]
"Semantic Versioning for Openconfig Models", <http://www.openconfig.net/docs/semver/>.

[semver] "Semantic Versioning 2.0.0", <https://www.semver.org>.

[yangcatalog]
"YANG Catalog", <https://yangcatalog.org>.

Appendix A. Appendix

A.1. Open Issues: Requirements to be Addressed

There are a few requirements of [I-D.verdt-netmod-yang-versioning-reqs] still to be addressed. These include the following:

- A solution is required for client compatibility to address requirements 3.1 and 3.2 from [I-D.verdt-netmod-yang-versioning-reqs]. This could include adding "module sets" support to ietf-yang-library where the client can choose one set with which to use.

- A solution for instance data to satisfy requirement 5.3 of [I-D.verdt-netmod-yang-versioning-reqs] is also required.

- While it is believed one could work within this semver scheme to support multiple parallel trains of development within a given YANG module, some thought should be given to how this would work in support of optional requirement 4.4 of [I-D.verdt-netmod-yang-versioning-reqs].

- While not mandatory, requirement 2.2 of [I-D.verdt-netmod-yang-versioning-reqs] looks to provide a way to determine, at the node level, whether or not changes have occurred between revisions of a given YANG module. This may require application of semver at the node level.

A.2. Open Issues

Additionally, there are a few open issues to be discussed and settled. These include the following:

- Do we need a new version of YANG?
  While eventually this will fold into a new version, the belief is this solution can work with extensions alone with an update to the [RFC7950] text concerning module updates.

- Should IETF/IANA officially generate derived semantic versions for their own modules? As they are the owner of the modules it should be their responsibility, but how to document it? Note that next round of funding for the yangcatalog.org could help develop the perfect derived-semantic-version toolset

- We could consider a new naming convention for module files. Today, module files are named using a module@revision.yang notation. We could consider module%semver.yang or

module#version.yang variants. Re-using the '@' for version is not ideal, so another separator character should be used. In this manner, both version and revision could be used.

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