                    RESTCONF Client and Server Models
                 draft-ietf-netconf-restconf-client-server-02

Abstract

   This document defines two YANG modules, one module to configure a
   RESTCONF client and the other module to configure a RESTCONF server.
   Both modules support the TLS transport protocol with both standard
   RESTCONF and RESTCONF Call Home connections.

Editorial Note (To be removed by RFC Editor)

   This draft contains many placeholder values that need to be replaced
   with finalized values at the time of publication. This note
   summarizes all of the substitutions that are needed. No other RFC
   Editor instructions are specified elsewhere in this document.

   This document contains references to other drafts in progress, both
   in the Normative References section, as well as in body text
   throughout. Please update the following references to reflect their
   final RFC assignments:

   o I-D.ietf-netconf-keystore

   o I-D.ietf-netconf-tls-client-server

   Artwork in this document contains shorthand references to drafts in
   progress. Please apply the following replacements:

   o "XXXX" --> the assigned RFC value for this draft

   o "ZZZZ" --> the assigned RFC value for I-D.ietf-netconf-tls-client-
      server

   Artwork in this document contains placeholder values for the date of
   publication of this draft. Please apply the following replacement:

   o "2017-03-13" --> the publication date of this draft

   The following two Appendix sections are to be removed prior to
   publication:

   o Appendix A. Change Log

   o Appendix B. Open Issues

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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   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 September 14, 2017.

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1. Introduction

   This document defines two YANG [RFC7950] modules, one module to
   configure a RESTCONF client and the other module to configure a
   RESTCONF server [RFC8040]. Both modules support the TLS [RFC5246]
   transport protocol with both standard RESTCONF and RESTCONF Call Home
   connections [RFC8071].

1.1. Terminology

   The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [RFC2119].

1.2. Tree Diagrams

   A simplified graphical representation of the data models is used in
   this document. The meaning of the symbols in these diagrams is as
   follows:

   o Brackets "[" and "]" enclose list keys.

   o Braces "{" and "}" enclose feature names, and indicate that the
      named feature must be present for the subtree to be present.

   o Abbreviations before data node names: "rw" means configuration
      (read-write) and "ro" state data (read-only).

   o Symbols after data node names: "?" means an optional node, "!"
      means a presence container, and "*" denotes a list and leaf-list.

   o Parentheses enclose choice and case nodes, and case nodes are also
      marked with a colon (":").

   o Ellipsis ("...") stands for contents of subtrees that are not
      shown.

2. The RESTCONF Client Model

   EDITOR NOTE: Please ignore this section, it is incomplete.

   The RESTCONF client model presented in this section supports both
   clients initiating connections to servers, as well as clients
   listening for connections from servers calling home.

   This model supports the TLS transport protocol using the TLS client
   groupings defined in [I-D.ietf-netconf-tls-client-server].

   All private keys and trusted certificates are held in the keystore
   model defined in [I-D.ietf-netconf-keystore].

   YANG feature statements are used to enable implementations to
   advertise which parts of the model the RESTCONF client supports.

2.1. Tree Diagram

   Note: all lines are folded at column 71 with no '\' character.

```
   module: ietf-restconf-client
      +--rw restconf-client
         +--rw initiate {initiate}?
         |  +--rw restconf-server* [name]
         |     +--rw name                    string
         |     +--rw (transport)
         |     |  +--:(tls) {tls-initiate}?
         |     |     +--rw tls
         |     |        +--rw endpoints
         |     |        |  +--rw endpoint* [name]
         |     |        |     +--rw name       string
         |     |        |     +--rw address    inet:host
         |     |        |     +--rw port?      inet:port-number
         |     |        +--rw server-auth
         |     |        |  +--rw trusted-ca-certs?       leafref
         |     |        |  +--rw trusted-server-certs?   leafref
         |     |        +--rw client-auth
         |     |        |  +--rw (auth-type)?
         |     |        |     +--:(certificate)
         |     |        |        +--rw certificate?   leafref
         |     |        +--rw hello-params
```

```
      |      |                    {tls-client-hello-params-config}?
      |      |              +--rw tls-versions
      |      |              |  +--rw tls-version*   identityref
      |      |              +--rw cipher-suites
      |      |                 +--rw cipher-suite*   identityref
      |      +--rw connection-type
      |      |  +--rw (connection-type)?
      |      |     +--:(persistent-connection)
      |      |     |  +--rw persistent!
      |      |     |     +--rw idle-timeout?   uint32
      |      |     |     +--rw keep-alives
      |      |     |        +--rw max-wait?       uint16
      |      |     |        +--rw max-attempts?   uint8
      |      |     +--:(periodic-connection)
      |      |        +--rw periodic!
      |      |           +--rw idle-timeout?        uint16
      |      |           +--rw reconnect-timeout?   uint16
      |      +--rw reconnect-strategy
      |         +--rw start-with?     enumeration
      |         +--rw max-attempts?   uint8
      +--rw listen {listen}?
         +--rw max-sessions?   uint16
         +--rw idle-timeout?   uint16
         +--rw endpoint* [name]
            +--rw name    string
            +--rw (transport)
               +--:(tls) {tls-listen}?
                  +--rw tls
                     +--rw address?           inet:ip-address
                     +--rw port?              inet:port-number
                     +--rw server-auth
                     |  +--rw trusted-ca-certs?       leafref
                     |  +--rw trusted-server-certs?   leafref
                     +--rw client-auth
                     |  +--rw (auth-type)?
                     |     +--:(certificate)
                     |        +--rw certificate?   leafref
                     +--rw hello-params
                           {tls-client-hello-params-config}?
                        +--rw tls-versions
                        |  +--rw tls-version*   identityref
                        +--rw cipher-suites
                           +--rw cipher-suite*   identityref
```

2.2. Example Usage

   The following example illustrates configuring a RESTCONF client to
   initiate connections, as well as listening for call-home connections.

   This example is consistent with the examples presented in Section 2.2
   of [I-D.ietf-netconf-keystore].

```
<restconf-client
  xmlns="urn:ietf:params:xml:ns:yang:ietf-restconf-client">

  <!-- RESTCONF servers to initiate connections to -->
  <initiate>
    <restconf-server>
      <name>corp-fw1</name>
      <tls>
        <endpoints>
          <endpoint>
            <name>corp-fw1.example.com</name>
            <address>corp-fw1.example.com</address>
          </endpoint>
          <endpoint>
            <name>corp-fw2.example.com</name>
            <address>corp-fw2.example.com</address>
          </endpoint>
        </endpoints>
        <server-auth>
          <trusted-server-certs>deployment-specific-ca-certs</trusted-server-cer
ts>
        </server-auth>
        <client-auth>
          <certificate>tls-ec-cert</certificate>
        </client-auth>
      </tls>
    </restconf-server>
  </initiate>

  <!-- endpoints to listen for RESTCONF Call Home connections on -->
  <listen>
    <endpoint>
      <name>Intranet-facing listener</name>
      <tls>
        <address>11.22.33.44</address>
        <server-auth>
          <trusted-ca-certs>deployment-specific-ca-certs</trusted-ca-certs>
          <trusted-server-certs>explicitly-trusted-server-certs</trusted-server-
certs>
        </server-auth>
        <client-auth>
          <certificate>tls-ec-cert</certificate>
        </client-auth>
      </tls>
    </endpoint>
  </listen>
</restconf-client>
```

2.3. YANG Model

   This YANG module imports YANG types from [RFC6991] and [RFC7407].

<CODE BEGINS> file "ietf-restconf-client@2017-03-13.yang"

```
module ietf-restconf-client {
  yang-version 1.1;

  namespace "urn:ietf:params:xml:ns:yang:ietf-restconf-client";
  prefix "rcc";

  import ietf-inet-types {
    prefix inet;
    reference
      "RFC 6991: Common YANG Data Types";
  }

  import ietf-tls-client {
    prefix ts;
    revision-date 2017-03-13; // stable grouping definitions
    reference
      "RFC ZZZZ: TLS Client and Server Models";
  }

  organization
   "IETF NETCONF (Network Configuration) Working Group";

  contact
   "WG Web:   <http://tools.ietf.org/wg/restconf/>
    WG List:  <mailto:restconf@ietf.org>

    Author:   Kent Watsen
              <mailto:kwatsen@juniper.net>

    Author:   Gary Wu
              <mailto:garywu@cisco.com>";


  description
   "This module contains a collection of YANG definitions for
    configuring RESTCONF clients.

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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
   (http://trustee.ietf.org/license-info).

   This version of this YANG module is part of RFC XXXX; see
   the RFC itself for full legal notices.";

 revision "2017-03-13" {
   description
    "Initial version";
   reference
    "RFC XXXX: RESTCONF Client and Server Models";
 }

 // Features

 feature initiate {
   description
    "The 'initiate' feature indicates that the RESTCONF client
     supports initiating RESTCONF connections to RESTCONF servers
     using at least one transport (e.g., TLS, etc.).";
 }

 feature tls-initiate {
   description
    "The 'tls-initiate' feature indicates that the RESTCONF client
     supports initiating TLS connections to RESTCONF servers.";
   reference
    "RFC 8040: RESTCONF Protocol";
 }

 feature listen {
   description
    "The 'listen' feature indicates that the RESTCONF client
     supports opening a port to accept RESTCONF server call
     home connections using at least one transport (e.g.,
     TLS, etc.).";
 }

 feature tls-listen {
   description
    "The 'tls-listen' feature indicates that the RESTCONF client
     supports opening a port to listen for incoming RESTCONF
     server call-home TLS connections.";
   reference
    "RFC 8071: NETCONF Call Home and RESTCONF Call Home";
```

```
   }

   container restconf-client {
     description
       "Top-level container for RESTCONF client configuration.";

     container initiate {
       if-feature initiate;
       description
         "Configures client initiating underlying TCP connections.";
       list restconf-server {
         key name;
         description
           "List of RESTCONF servers the RESTCONF client is to initiate
            connections to.";
         leaf name {
           type string;
           description
             "An arbitrary name for the RESTCONF server.";
         }
         choice transport {
           mandatory true;
           description
             "Selects between available transports.";

           case tls {
             if-feature tls-initiate;
             container tls {
               description
                 "Specifies TLS-specific transport configuration.";
               uses endpoints-container {
                 refine endpoints/endpoint/port {
                   default 443;
                 }
               }
               uses ts:tls-client-grouping;
             }
           } // end tls

         } // end transport

         container connection-type {
           description
            "Indicates the kind of connection to use.";
           choice connection-type {
             description
               "Selects between available connection types.";
             case persistent-connection {
```

```
            container persistent {
              presence true;
              description
               "Maintain a persistent connection to the RESTCONF
                server. If the connection goes down, immediately
                start trying to reconnect to it, using the
                reconnection strategy.

                This connection type minimizes any RESTCONF server
                to RESTCONF client data-transfer delay, albeit at
                the expense of holding resources longer.";
              leaf idle-timeout {
                type uint32;
                units "seconds";
                default 86400;  // one day;
                description
                  "Specifies the maximum number of seconds that a
                   a RESTCONF session may remain idle. A RESTCONF
                   session will be dropped if it is idle for an
                   interval longer than this number of seconds.
                   If set to zero, then the client will never drop
                   a session because it is idle.  Sessions that
                   have a notification subscription active are
                   never dropped.";
              }
              container keep-alives {
                description
                  "Configures the keep-alive policy, to proactively
                   test the aliveness of the SSH/TLS server.  An
                   unresponsive SSH/TLS server will be dropped after
                   approximately max-attempts * max-wait seconds.";
                reference
                  "RFC 8071: NETCONF Call Home and RESTCONF Call
                   Home, Section 3.1, item S6";
                leaf max-wait {
                  type uint16 {
                    range "1..max";
                  }
                  units seconds;
                  default 30;
                  description
                   "Sets the amount of time in seconds after which
                    if no data has been received from the SSH/TLS
                    server, a SSH/TLS-level message will be sent
                    to test the aliveness of the SSH/TLS server.";
                }
                leaf max-attempts {
                  type uint8;
```

```
                    default 3;
                    description
                      "Sets the maximum number of sequential keep-alive
                       messages that can fail to obtain a response from
                       the SSH/TLS server before assuming the SSH/TLS
                       server is no longer alive.";
                  }
                }
              }
            }
            case periodic-connection {
              container periodic {
                presence true;
                description
                  "Periodically connect to the RESTCONF server, so that
                   the RESTCONF server may deliver messages pending for
                   the RESTCONF client.  The RESTCONF server must close
                   the connection when it is ready to release it. Once
                   the connection has been closed, the RESTCONF client
                   will restart its timer until the next connection.";
                leaf idle-timeout {
                  type uint16;
                  units "seconds";
                  default 300; // five minutes
                  description
                    "Specifies the maximum number of seconds that a
                     a RESTCONF session may remain idle. A RESTCONF
                     session will be dropped if it is idle for an
                     interval longer than this number of seconds.
                     If set to zero, then the server will never drop
                     a session because it is idle.  Sessions that
                     have a notification subscription active are
                     never dropped.";
                }
                leaf reconnect-timeout {
                  type uint16 {
                    range "1..max";
                  }
                  units minutes;
                  default 60;
                  description
                    "Sets the maximum amount of unconnected time the
                     RESTCONF client will wait before re-establishing
                     a connection to the RESTCONF server.  The RESTCONF
                     client may initiate a connection before this
                     time if desired (e.g., to set configuration).";
                }
              }
```

```
                }
              }
            }
          container reconnect-strategy {
            description
             "The reconnection strategy directs how a RESTCONF client
              reconnects to a RESTCONF server, after discovering its
              connection to the server has dropped, even if due to a
              reboot.  The RESTCONF client starts with the specified
              endpoint and tries to connect to it max-attempts times
              before trying the next endpoint in the list (round
              robin).";
            leaf start-with {
              type enumeration {
                enum first-listed {
                  description
                    "Indicates that reconnections should start with
                     the first endpoint listed.";
                }
                enum last-connected {
                  description
                    "Indicates that reconnections should start with
                     the endpoint last connected to.  If no previous
                     connection has ever been established, then the
                     first endpoint configured is used.   RESTCONF
                     clients SHOULD be able to remember the last
                     endpoint connected to across reboots.";
                }
              }
              default first-listed;
              description
               "Specifies which of the RESTCONF server's endpoints the
                RESTCONF client should start with when trying to connect
                to the RESTCONF server.";
            }
            leaf max-attempts {
              type uint8 {
                range "1..max";
              }
              default 3;
              description
               "Specifies the number times the RESTCONF client tries to
                connect to a specific endpoint before moving on to the
                next endpoint in the list (round robin).";
            }
          }
        } // end restconf-server
      } // end initiate
```

```
     container listen {
       if-feature listen;
       description
         "Configures client accepting call-home TCP connections.";

       leaf max-sessions {
         type uint16;
         default 0;
         description
           "Specifies the maximum number of concurrent sessions
            that can be active at one time.  The value 0 indicates
            that no artificial session limit should be used.";
       }

       leaf idle-timeout {
         type uint16;
         units "seconds";
         default 3600; // one hour
         description
           "Specifies the maximum number of seconds that a RESTCONF
            session may remain idle. A RESTCONF session will be dropped
            if it is idle for an interval longer than this number of
            seconds.  If set to zero, then the server will never drop
            a session because it is idle.  Sessions that have a
            notification subscription active are never dropped.";
       }

       list endpoint {
         key name;
         description
           "List of endpoints to listen for RESTCONF connections.";
         leaf name {
           type string;
           description
             "An arbitrary name for the RESTCONF listen endpoint.";
         }
         choice transport {
           mandatory true;
           description
             "Selects between available transports.";
           case tls {
             if-feature tls-listen;
             container tls {
               description
                 "TLS-specific listening configuration for inbound
                  connections.";
               leaf address {
                 type inet:ip-address;
```

```
                    description
                     "The IP address to listen for call-home connections.";
                  }
                  leaf port {
                    type inet:port-number;
                    default 4336;
                    description
                     "The port number to listen for call-home connections.";
                  }
                  uses ts:tls-client-grouping;
                }
              }
          } // end transport
        } // end endpoint
      } // end listen

  } // end restconf-client


  grouping endpoints-container {
    description
      "This grouping is used to configure a set of RESTCONF servers
       a RESTCONF client may initiate connections to.";
    container endpoints {
      description
        "Container for the list of endpoints.";
      list endpoint {
        key name;
        unique "address port";
        min-elements 1;
        ordered-by user;
        description
          "A non-empty user-ordered list of endpoints for this RESTCONF
           client to try to connect to.  Defining more than one enables
           high-availability.";
        leaf name {
          type string;
          description
            "An arbitrary name for this endpoint.";
        }
        leaf address {
          type inet:host;
          mandatory true;
          description
           "The IP address or hostname of the endpoint.  If a
            hostname is configured and the DNS resolution results
            in more than one IP address, the RESTCONF client
            will process the IP addresses as if they had been
```

```
           explicitly configured in place of the hostname.";
        }
        leaf port {
          type inet:port-number;
          description
           "The IP port for this endpoint. The RESTCONF client will
            use the IANA-assigned well-known port (set via a refine
            statement when uses) if no value is specified.";
        }
      }
    }
  }
}
```

<CODE ENDS>

3. The RESTCONF Server Model

   The RESTCONF Server model presented in this section supports servers
   both listening for connections as well as initiating call-home
   connections.

   This model supports the TLS transport protocol using the TLS server
   groupings defined in [I-D.ietf-netconf-tls-client-server].

   All private keys and trusted certificates are held in the keystore
   model defined in [I-D.ietf-netconf-keystore].

   YANG feature statements are used to enable implementations to
   advertise which parts of the model the RESTCONF server supports.

3.1. Tree Diagram

   Note: all lines are folded at column 71 with no '\' character.

```
module: ietf-restconf-server
   +--rw restconf-server
      +--rw listen {listen}?
      |  +--rw max-sessions?   uint16
      |  +--rw endpoint* [name]
      |     +--rw name     string
      |     +--rw (transport)
      |        +--:(tls) {tls-listen}?
      |           +--rw tls
      |              +--rw address?          inet:ip-address
      |              +--rw port?             inet:port-number
      |              +--rw certificates
      |              |  +--rw certificate* [name]
```

```
       |              |  +--rw name     leafref
       |              +--rw client-auth
       |              |  +--rw trusted-ca-certs?       leafref
       |              |  +--rw trusted-client-certs?   leafref
       |              |  +--rw cert-maps
       |              |     +--rw cert-to-name* [id]
       |              |        +--rw id            uint32
       |              |        +--rw fingerprint   x509c2n:tls-fingerprint
       |              |        +--rw map-type      identityref
       |              |        +--rw name          string
       |              +--rw hello-params
       |                    {tls-server-hello-params-config}?
       |                 +--rw tls-versions
       |                 |  +--rw tls-version*   identityref
       |                 +--rw cipher-suites
       |                    +--rw cipher-suite*   identityref
       +--rw call-home {call-home}?
          +--rw restconf-client* [name]
             +--rw name                    string
             +--rw (transport)
             |  +--:(tls) {tls-call-home}?
             |     +--rw tls
             |        +--rw endpoints
             |        |  +--rw endpoint* [name]
             |        |     +--rw name      string
             |        |     +--rw address   inet:host
             |        |     +--rw port?     inet:port-number
             |        +--rw certificates
             |        |  +--rw certificate* [name]
             |        |     +--rw name     leafref
             |        +--rw client-auth
             |        |  +--rw trusted-ca-certs?       leafref
             |        |  +--rw trusted-client-certs?   leafref
             |        |  +--rw cert-maps
             |        |     +--rw cert-to-name* [id]
             |        |        +--rw id            uint32
             |        |        +--rw fingerprint   x509c2n:tls-fingerprint
             |        |        +--rw map-type      identityref
             |        |        +--rw name          string
             |        +--rw hello-params
             |              {tls-server-hello-params-config}?
             |           +--rw tls-versions
             |           |  +--rw tls-version*   identityref
             |           +--rw cipher-suites
             |              +--rw cipher-suite*   identityref
             +--rw connection-type
             |  +--rw (connection-type)?
             |     +--:(persistent-connection)
```

```
            |  |   +--rw persistent!
            |  |      +--rw keep-alives
            |  |         +--rw max-wait?       uint16
            |  |         +--rw max-attempts?   uint8
            |  +--:(periodic-connection)
            |     +--rw periodic!
            |        +--rw reconnect-timeout?   uint16
      +--rw reconnect-strategy
         +--rw start-with?     enumeration
         +--rw max-attempts?   uint8
```

3.2. Example Usage

   The following example illustrates configuring a RESTCONF server to
   listen for RESTCONF client connections, as well as configuring call-
   home to one RESTCONF client.

   This example is consistent with the examples presented in Section 2.2
   of [I-D.ietf-netconf-keystore].

```
<restconf-server
  xmlns="urn:ietf:params:xml:ns:yang:ietf-restconf-server"
  xmlns:x509c2n="urn:ietf:params:xml:ns:yang:ietf-x509-cert-to-name">

  <!-- listening for TLS (HTTPS) connections -->
  <listen>
    <endpoint>
      <name>netconf/tls</name>
      <tls>
        <address>11.22.33.44</address>
        <certificates>
          <certificate>
            <name>tls-ec-cert</name>
          </certificate>
        </certificates>
        <client-auth>
          <trusted-ca-certs>deployment-specific-ca-certs</trusted-ca-certs>
          <trusted-client-certs>explicitly-trusted-client-certs</trusted-client-
certs>
          <cert-maps>
            <cert-to-name>
              <id>1</id>
              <fingerprint>11:0A:05:11:00</fingerprint>
              <map-type>x509c2n:san-any</map-type>
            </cert-to-name>
            <cert-to-name>
              <id>2</id>
              <fingerprint>B3:4F:A1:8C:54</fingerprint>
              <map-type>x509c2n:specified</map-type>
```

```
                    <name>scooby-doo</name>
                  </cert-to-name>
                </cert-maps>
              </client-auth>
            </tls>
          </endpoint>
      </listen>

      <!-- calling home to a RESTCONF client -->
      <call-home>
        <restconf-client>
          <name>config-manager</name>
          <tls>
            <endpoints>
              <endpoint>
                <name>east-data-center</name>
                <address>22.33.44.55</address>
              </endpoint>
              <endpoint>
                <name>west-data-center</name>
                <address>33.44.55.66</address>
              </endpoint>
            </endpoints>
            <certificates>
              <certificate>
                <name>tls-ec-cert</name>
              </certificate>
            </certificates>
            <client-auth>
              <trusted-ca-certs>deployment-specific-ca-certs</trusted-ca-certs>
              <trusted-client-certs>explicitly-trusted-client-certs</trusted-client-
certs>
              <cert-maps>
                <cert-to-name>
                  <id>1</id>
                  <fingerprint>11:0A:05:11:00</fingerprint>
                  <map-type>x509c2n:san-any</map-type>
                </cert-to-name>
                <cert-to-name>
                  <id>2</id>
                  <fingerprint>B3:4F:A1:8C:54</fingerprint>
                  <map-type>x509c2n:specified</map-type>
                  <name>scooby-doo</name>
                </cert-to-name>
              </cert-maps>
            </client-auth>
          </tls>
          <connection-type>
            <periodic>
```

```
          <idle-timeout>300</idle-timeout>
          <reconnect-timeout>60</reconnect-timeout>
        </periodic>
      </connection-type>
      <reconnect-strategy>
        <start-with>last-connected</start-with>
        <max-attempts>3</max-attempts>
      </reconnect-strategy>
    </restconf-client>
  </call-home>

</restconf-server>
```

3.3. YANG Model

   This YANG module imports YANG types from [RFC6991] and [RFC7407].

<CODE BEGINS> file "ietf-restconf-server@2017-03-13.yang"

```
module ietf-restconf-server {
  yang-version 1.1;

  namespace "urn:ietf:params:xml:ns:yang:ietf-restconf-server";
  prefix "rcs";

  //import ietf-netconf-acm {
  //  prefix nacm;
  //  reference
  //    "RFC 6536: Network Configuration Protocol (NETCONF)
  //     Access Control Model";
  //}

  import ietf-inet-types {
    prefix inet;
    reference
      "RFC 6991: Common YANG Data Types";
  }

  import ietf-x509-cert-to-name {
    prefix x509c2n;
    reference
      "RFC 7407: A YANG Data Model for SNMP Configuration";
  }

  import ietf-tls-server {
    prefix ts;
    revision-date 2017-03-13; // stable grouping definitions
```

```
     reference
       "RFC ZZZZ: TLS Client and Server Models";
  }

  organization
   "IETF NETCONF (Network Configuration) Working Group";

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

    WG Chair: Mehmet Ersue
              <mailto:mehmet.ersue@nsn.com>

    WG Chair: Mahesh Jethanandani
              <mailto:mjethanandani@gmail.com>

    Editor:   Kent Watsen
              <mailto:kwatsen@juniper.net>";


  description
   "This module contains a collection of YANG definitions for
    configuring RESTCONF servers.

    Copyright (c) 2014 IETF Trust and the persons identified as
    authors of the code. All rights reserved.

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

    This version of this YANG module is part of RFC XXXX; see
    the RFC itself for full legal notices.";

  revision "2017-03-13" {
    description
     "Initial version";
    reference
     "RFC XXXX: RESTCONF Client and Server Models";
  }


  // Features
```

```
   feature listen {
     description
      "The 'listen' feature indicates that the RESTCONF server
       supports opening a port to accept RESTCONF client connections
       using at least one transport (e.g., TLS, etc.).";
   }

   feature tls-listen {
     description
      "The 'tls-listen' feature indicates that the RESTCONF server
       supports opening a port to listen for incoming RESTCONF
       client connections.";
     reference
      "RFC XXXX: RESTCONF Protocol";
   }

   feature call-home {
     description
      "The 'call-home' feature indicates that the RESTCONF server
       supports initiating RESTCONF call home connections to REETCONF
       clients using at least one transport (e.g., TLS, etc.).";
     reference
      "RFC 8071: NETCONF Call Home and RESTCONF Call Home";
   }

   feature tls-call-home {
     description
      "The 'tls-call-home' feature indicates that the RESTCONF server
       supports initiating connections to RESTCONF clients.";
     reference
      "RFC 8071: NETCONF Call Home and RESTCONF Call Home";
   }

   feature client-cert-auth {
     description
      "The client-cert-auth feature indicates that the RESTCONF
       server supports the ClientCertificate authentication scheme.";
     reference
      "RFC ZZZZ: Client Authentication over New TLS Connection";
   }


   // top-level container
   container restconf-server {
     description
       "Top-level container for RESTCONF server configuration.";

     container listen {
```

```
        if-feature listen;
        description
          "Configures listen behavior";
        leaf max-sessions {
          type uint16;
          default 0;    // should this be 'max'?
          description
            "Specifies the maximum number of concurrent sessions
             that can be active at one time.  The value 0 indicates
             that no artificial session limit should be used.";
        }
        list endpoint {
          key name;
          description
            "List of endpoints to listen for RESTCONF connections.";
          leaf name {
            type string;
            description
              "An arbitrary name for the RESTCONF listen endpoint.";
          }
          choice transport {
            mandatory true;
            description
              "Selects between available transports.";
            case tls {
              if-feature tls-listen;
              container tls {
                description
                  "TLS-specific listening configuration for inbound
                   connections.";
                leaf address {
                  type inet:ip-address;
                  description
                   "The IP address of the interface to listen on.  The
                    TLS server will listen on all interfaces if no value
                    is specified.  Please note that some addresses have
                    special meanings (e.g., '0.0.0.0' and '::').";
                }
                leaf port {
                  type inet:port-number;
                  default 443;
                  description
                   "The local port number on this interface the TLS server
                    listens on.";
                }
                uses ts:tls-server-grouping {
                  augment "client-auth" {
                    description
```

```
                    "Augments in the cert-to-name structure.";
                  uses cert-maps-grouping;
                }
              }
            }
          }
        }
      }
    }

    container call-home {
      if-feature call-home;
      description
        "Configures call-home behavior";
      list restconf-client {
        key name;
        description
          "List of RESTCONF clients the RESTCONF server is to
           initiate call-home connections to.";
        leaf name {
          type string;
          description
            "An arbitrary name for the remote RESTCONF client.";
        }
        choice transport {
          mandatory true;
          description
            "Selects between TLS and any transports augmented in.";
          case tls {
            if-feature tls-call-home;
            container tls {
              description
                "Specifies TLS-specific call-home transport
                 configuration.";
              uses endpoints-container {
                refine endpoints/endpoint/port {
                  default 4336;
                }
              }
              uses ts:tls-server-grouping {
                augment "client-auth" {
                  description
                    "Augments in the cert-to-name structure.";
                  uses cert-maps-grouping;
                }
              }
            }
          }
```

```
          }
          container connection-type {
            description
             "Indicates the RESTCONF client's preference for how the
              RESTCONF server's connection is maintained.";
            choice connection-type {
              description
                "Selects between available connection types.";
              case persistent-connection {
                container persistent {
                  presence true;
                  description
                   "Maintain a persistent connection to the RESTCONF
                    client. If the connection goes down, immediately
                    start trying to reconnect to it, using the
                    reconnection strategy.

                    This connection type minimizes any RESTCONF client
                    to RESTCONF server data-transfer delay, albeit at
                    the expense of holding resources longer.";

                  container keep-alives {
                    description
                      "Configures the keep-alive policy, to proactively
                       test the aliveness of the TLS client.  An
                       unresponsive TLS client will be dropped after
                       approximately (max-attempts * max-wait)
                       seconds.";
                    reference
                      "RFC 8071: NETCONF Call Home and RESTCONF Call
                       Home, Section 3.1, item S6";
                    leaf max-wait {
                      type uint16 {
                        range "1..max";
                      }
                      units seconds;
                      default 30;
                      description
                       "Sets the amount of time in seconds after which
                        if no data has been received from the TLS
                        client, a TLS-level message will be sent to
                        test the aliveness of the TLS client.";
                    }
                    leaf max-attempts {
                      type uint8;
                      default 3;
                      description
                       "Sets the maximum number of sequential keep-alive
```

```
                            messages that can fail to obtain a response from
                            the TLS client before assuming the TLS client is
                            no longer alive.";
                    }
                  }
                }
              }
              case periodic-connection {
                container periodic {
                  presence true;
                  description
                   "Periodically connect to the RESTCONF client, so that
                    the RESTCONF client may deliver messages pending for
                    the RESTCONF server.  The client must close the
                    connection when it's ready to release it.  Once the
                    connection has been closed, the server will restart
                    its timer until the next connection.";
                  leaf reconnect-timeout {
                    type uint16 {
                      range "1..max";
                    }
                    units minutes;
                    default 60;
                    description
                     "The maximum amount of unconnected time the
                      RESTCONF server will wait before re-establishing
                      a connection to the RESTCONF client.  The
                      RESTCONF server may initiate a connection to
                      the RESTCONF client before this time if desired
                      (e.g., to deliver a notification).";
                  }
                }
              }
            }
          }
          container reconnect-strategy {
            description
             "The reconnection strategy directs how a RESTCONF server
              reconnects to a RESTCONF client after after discovering
              its connection to the client has dropped, even if due to
              a reboot.  The RESTCONF server starts with the specified
              endpoint and tries to connect to it max-attempts times
              before trying the next endpoint in the list (round
              robin).";
            leaf start-with {
              type enumeration {
                enum first-listed {
                  description
```

```
                     "Indicates that reconnections should start with
                      the first endpoint listed.";
                 }
               enum last-connected {
                  description
                    "Indicates that reconnections should start with
                     the endpoint last connected to.  If no previous
                     connection has ever been established, then the
                     first endpoint configured is used.   RESTCONF
                     servers SHOULD be able to remember the last
                     endpoint connected to across reboots.";
                 }
               }
             default first-listed;
             description
              "Specifies which of the RESTCONF client's endpoints the
               RESTCONF server should start with when trying to connect
               to the RESTCONF client.";
           }
           leaf max-attempts {
             type uint8 {
               range "1..max";
             }
             default 3;
             description
              "Specifies the number times the RESTCONF server tries to
               connect to a specific endpoint before moving on to the
               next endpoint in the list (round robin).";
           }
         }
       }
     }
   }


   grouping cert-maps-grouping {
     description
       "A grouping that defines a container around the
        cert-to-name structure defined in RFC 7407.";
     container cert-maps {
       uses x509c2n:cert-to-name;
       description
        "The cert-maps container is used by a TLS-based RESTCONF
         server to map the RESTCONF client's presented X.509
         certificate to a RESTCONF username.  If no matching and
         valid cert-to-name list entry can be found, then the
         RESTCONF server MUST close the connection, and MUST NOT
         accept RESTCONF messages over it.";
```

```
      reference
        "RFC XXXX: The RESTCONF Protocol";
    }
  }


  grouping endpoints-container {
    description
      "This grouping is used by tls container for call-home
       configurations.";
    container endpoints {
      description
        "Container for the list of endpoints.";
      list endpoint {
        key name;
        unique "address port";
        min-elements 1;
        ordered-by user;
        description
          "User-ordered list of endpoints for this RESTCONF client.
           Defining more than one enables high-availability.";
        leaf name {
          type string;
          description
            "An arbitrary name for this endpoint.";
        }
        leaf address {
          type inet:host;
          mandatory true;
          description
           "The IP address or hostname of the endpoint.  If a
            hostname is configured and the DNS resolution results
            in more than one IP address, the RESTCONF server
            will process the IP addresses as if they had been
            explicitly configured in place of the hostname.";
        }
        leaf port {
          type inet:port-number;
          description
           "The IP port for this endpoint. The RESTCONF server will
            use the IANA-assigned well-known port if no value is
            specified.";
        }
      }
    }
  }
```

}

<CODE ENDS>

4. Security Considerations

   The YANG module defined in this document uses a grouping defined in
   [I-D.ietf-netconf-tls-client-server]. Please see the Security
   Considerations section in that document for concerns related that
   grouping.

   The YANG module defined in this document is designed to be accessed
   via YANG based management protocols, such as NETCONF [RFC6241] and
   RESTCONF [RFC8040]. Both of these protocols have mandatory-to-
   implement secure transport layers (e.g., SSH, TLS) with mutual
   authentication.

   The NETCONF access control model (NACM) [RFC6536] provides the means
   to restrict access for particular users to a pre-configured subset of
   all available 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. These are the subtrees and data nodes
   and their sensitivity/vulnerability:

      NONE

   Some of the readable data nodes in this YANG module may be considered
   sensitive or vulnerable in some network environments. It is thus
   important to control read access (e.g., via get, get-config, or
   notification) to these data nodes. These are the subtrees and data
   nodes and their sensitivity/vulnerability:

      NONE

   Some of the RPC operations in this YANG module may be considered
   sensitive or vulnerable in some network environments. It is thus
   important to control access to these operations. These are the
   operations and their sensitivity/vulnerability:

      NONE

5. IANA Considerations

5.1. The IETF XML Registry

   This document registers two URIs in the IETF XML registry [RFC3688].
   Following the format in [RFC3688], the following registrations are
   requested:

      URI: urn:ietf:params:xml:ns:yang:ietf-restconf-client
      Registrant Contact: The NETCONF WG of the IETF.
      XML: N/A, the requested URI is an XML namespace.

      URI: urn:ietf:params:xml:ns:yang:ietf-restconf-server
      Registrant Contact: The NETCONF WG of the IETF.
      XML: N/A, the requested URI is an XML namespace.

5.2. The YANG Module Names Registry

   This document registers two YANG modules in the YANG Module Names
   registry [RFC7950]. Following the format in [RFC7950], the the
   following registrations are requested:

      name: ietf-restconf-client
      namespace: urn:ietf:params:xml:ns:yang:ietf-restconf-client
      prefix: ncc
      reference: RFC XXXX

      name: ietf-restconf-server
      namespace: urn:ietf:params:xml:ns:yang:ietf-restconf-server
      prefix: ncs
      reference: RFC XXXX

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   and Bert Wijnen.

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   Excellence project (ICT-318488) supported by the European Commission
   under its Seventh Framework Programme.

7. References

7.1. Normative References

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Appendix A.   Change Log

A.1.   server-model-09 to 00

   o This draft was split out from draft-ietf-netconf-server-model-09.

   o Added in new features 'listen' and 'call-home' so future
      transports can be augmented in.

A.2.   00 to 01

   o Renamed "keychain" to "keystore".

A.3.   01 to 02

   o Filled in previously missing 'ietf-restconf-client' module.

   o Updated the ietf-restconf-server module to accomodate new grouping
      'ietf-tls-server-grouping'.

Appendix B.   Open Issues

   Please see: https://github.com/netconf-wg/restconf-client-server/
   issues.

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