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 YANG Groupings for TCP Clients and TCP Servers

Abstract

This document presents three YANG 1.1 modules to support the configuration of TCP clients and TCP servers. The modules include basic parameters of a TCP connection relevant for client or server applications, as well as client configuration required for traversing proxies. The modules can be used either standalone or in conjunction with configuration of other stack protocol layers.

Editorial Note (To be removed by RFC Editor)

This draft contains 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.

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

*AAAA --> the assigned RFC value for draft-ietf-netconf-crypto-types

*DDDD --> the assigned RFC value for this draft

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

*2024-02-22 --> the publication date of this draft

The "Relation to other RFCs" section [Section 1.1](#) contains the text "one or more YANG modules" and, later, "modules". This text is sourced from a file in a context where it is unknown how many modules a draft defines. The text is not wrong as is, but it may be improved by stating more directly how many modules are defined.

The "Relation to other RFCs" section [Section 1.1](#) contains a self-reference to this draft, along with a corresponding reference in the Appendix. Please replace the self-reference in this section with

"This RFC" (or similar) and remove the self-reference in the "Normative/Informative References" section, whichever it is in.

Tree-diagrams in this draft may use the '\' line-folding mode defined in RFC 8792. However, nicer-to-the-eye is when the '\\\ line-folding mode is used. The AD suggested suggested putting a request here for the RFC Editor to help convert "ugly" '\' folded examples to use the '\\\ folding mode. "Help convert" may be interpreted as, identify what looks ugly and ask the authors to make the adjustment.

The following Appendix section is to be removed prior to publication:

*[Appendix A](#). Change Log

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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1. Introduction

This document defines three YANG 1.1 [[RFC7950](#)] modules to support the configuration of TCP clients and TCP servers (TCP is defined in [[RFC9293](#)]), either as standalone or in conjunction with configuration of other stack protocol layers.

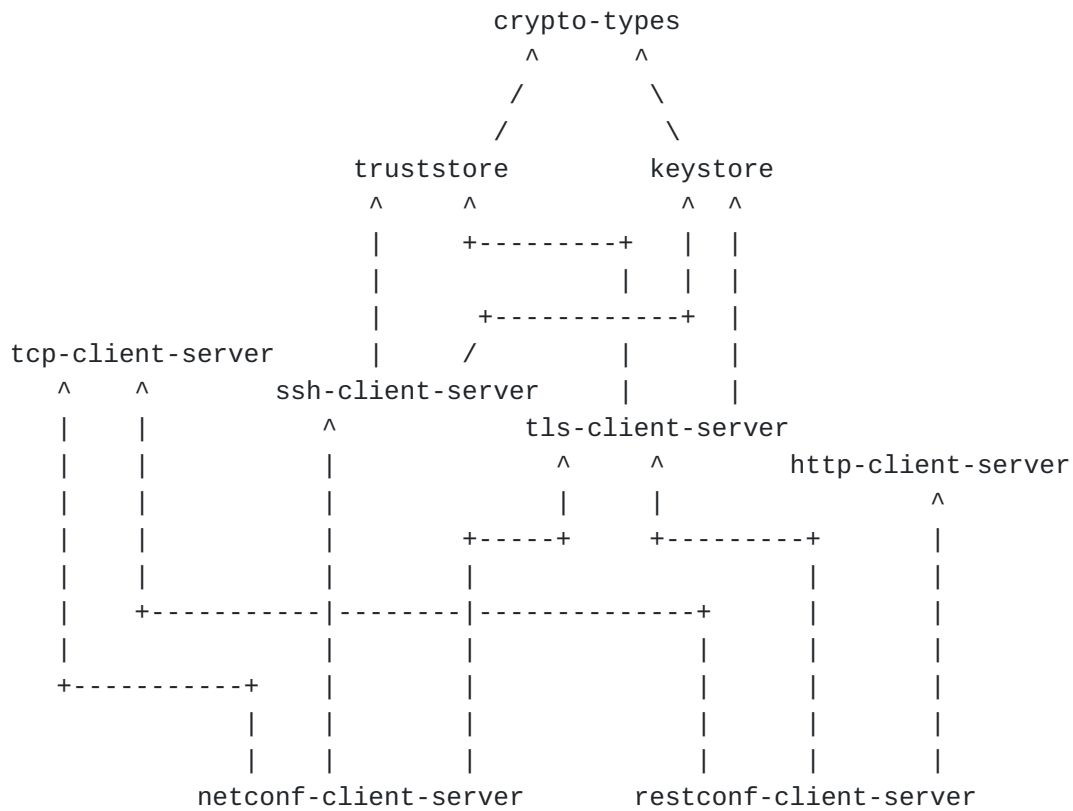
The modules focus on three different types of base TCP parameters that matter for TCP-based applications: First, the modules cover fundamental configuration of a TCP client or TCP server application, such as addresses and port numbers. Second, a reusable grouping enables modification of application-specific parameters for a TCP connections, such as use of TCP keep-alives. And third, client configuration for traversing proxies is included as well. In each case, the modules have a very narrow scope and focus on a minimum set of required parameters.

1.1. Relation to other RFCs

This document presents one or more YANG modules [[RFC7950](#)] that are part of a collection of RFCs that work together to, ultimately, support the configuration of both the clients and servers of both the NETCONF [[RFC6241](#)] and RESTCONF [[RFC8040](#)] protocols.

The dependency relationship between the primary YANG groupings defined in the various RFCs is presented in the below diagram. In some cases, a draft may define secondary groupings that introduce dependencies not illustrated in the diagram. The labels in the diagram are a shorthand name for the defining RFC. The citation reference for shorthand name is provided below the diagram.

Please note that the arrows in the diagram point from referencer to referenced. For example, the "crypto-types" RFC does not have any dependencies, whilst the "keystore" RFC depends on the "crypto-types" RFC.



| Label in Diagram | Originating RFC |
|------------------------|---|
| crypto-types | [I-D.ietf-netconf-crypto-types] |
| truststore | [I-D.ietf-netconf-trust-anchors] |
| keystore | [I-D.ietf-netconf-keystore] |
| tcp-client-server | [I-D.ietf-netconf-tcp-client-server] |
| ssh-client-server | [I-D.ietf-netconf-ssh-client-server] |
| tls-client-server | [I-D.ietf-netconf-tls-client-server] |
| http-client-server | [I-D.ietf-netconf-http-client-server] |
| netconf-client-server | [I-D.ietf-netconf-netconf-client-server] |
| restconf-client-server | [I-D.ietf-netconf-restconf-client-server] |

Table 1: Label in Diagram to RFC Mapping

1.2. Specification 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 BCP 14 [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

1.3. Adherence to the NMDA

This document is compliant with the Network Management Datastore Architecture (NMDA) [[RFC8342](#)]. It does not define any protocol accessible nodes that are "config false".

2. The "ietf-tcp-common" Module

This section defines a YANG 1.1 module called "ietf-tcp-common". A high-level overview of the module is provided in [Section 2.1](#). Examples illustrating the module's use are provided in [Examples \(Section 2.2\)](#). The YANG module itself is defined in [Section 2.3](#).

2.1. Data Model Overview

This section provides an overview of the "ietf-tcp-common" module in terms of its features and groupings.

2.1.1. Model Scope

This document presents a common "grouping" statement for basic TCP connection parameters that matter to applications. It is "common" in that this grouping is used by both the "ietf-tcp-client" and "ietf-tcp-server" modules. In some TCP stacks, such parameters can also directly be set by an application using system calls, such as the sockets API. The base YANG model in this document focuses on modeling TCP keep-alives. This base model can be extended as needed.

2.1.2. Features

The following diagram lists all the "feature" statements defined in the "ietf-tcp-common" module:

Features:

```
+-- keepalives-supported
```

The diagram above uses syntax that is similar to but not defined in [[RFC8340](#)].

2.1.3. Groupings

The "ietf-tcp-common" module defines the following "grouping" statement:

```
*tcp-common-grouping
```

This grouping is presented in the following subsection.

2.1.3.1. The "tcp-common-grouping" Grouping

The following tree diagram [[RFC8340](#)] illustrates the "tcp-common-grouping" grouping:

```
grouping tcp-common-grouping:
  +-- keepalives! {keepalives-supported}?
     +-- idle-time?          uint16
     +-- max-probes?        uint16
     +-- probe-interval?    uint16
```

Comments:

*The "keepalives" node is a "presence" container so that the mandatory descendant nodes do not imply that keepalives must be configured.

*The "idle-time", "max-probes", and "probe-interval" nodes have the common meanings. Please see the YANG module in [Section 2.3](#) for details.

2.1.4. Protocol-accessible Nodes

The "ietf-tcp-common" module defines only "grouping" statements that are used by other modules to instantiate protocol-accessible nodes. Thus this module, when implemented, does not itself define any protocol-accessible nodes.

2.1.5. Guidelines for Configuring TCP Keep-Alives

Network stacks may include "keep-alives" in their TCP implementations, although this practice is not universally accepted. If keep-alives are included, [[RFC9293](#)] mandates that the application MUST be able to turn them on or off for each TCP connection, and that they MUST default to off.

Keep-alive mechanisms exist in many protocols. Depending on the protocol stack, TCP keep-alives may only be one out of several alternatives. Which mechanism(s) to use depends on the use case and application requirements. If keep-alives are needed by an application, it is RECOMMENDED that the liveness check happens only at the protocol layers that are meaningful to the application.

A TCP keep-alive mechanism SHOULD only be invoked in server applications that might otherwise hang indefinitely and consume resources unnecessarily if a client crashes or aborts a connection during a network failure [[RFC9293](#)]. TCP keep-alives may consume significant resources both in the network and in endpoints (e.g., battery power). In addition, frequent keep-alives risk network

congestion. The higher the frequency of keep-alives, the higher the overhead.

Given the cost of keep-alives, parameters have to be configured carefully:

*The default idle interval (leaf "idle-time") is two hours, i.e., 7200 seconds [[RFC9293](#)]. A lower value MAY be configured, but idle intervals SHOULD NOT be smaller than 15 seconds. Longer idle intervals SHOULD be used when possible.

*The maximum number of sequential keep-alive probes that can fail (leaf "max-probes") trades off responsiveness and robustness against packet loss. ACK segments that contain no data are not reliably transmitted by TCP. Consequently, if a keep-alive mechanism is implemented it MUST NOT interpret failure to respond to any specific probe as a dead connection [[RFC9293](#)]. Typically, a single-digit number should suffice.

*TCP implementations may include a parameter for the number of seconds between TCP keep-alive probes (leaf "probe-interval"). In order to avoid congestion, the time interval between probes MUST NOT be smaller than one second. Significantly longer intervals SHOULD be used. It is important to note that keep-alive probes (or replies) can get dropped due to network congestion. Sending further probe messages into a congested path after a short interval, without backing off timers, could cause harm and result in a congestion collapse. Therefore it is essential to pick a large, conservative value for this interval.

2.2. Example Usage

This section presents an example showing the "tcp-common-grouping" populated with some data.

```
<!-- The outermost element below doesn't exist in the data model. -->
<!-- It simulates if the "grouping" were a "container" instead. -->

<tcp-common xmlns="urn:ietf:params:xml:ns:yang:ietf-tcp-common">
  <keepalives>
    <idle-time>7200</idle-time>
    <max-probes>9</max-probes>
    <probe-interval>75</probe-interval>
  </keepalives>
</tcp-common>
```

2.3. YANG Module

The ietf-tcp-common YANG module references [[RFC6991](#)] and [[RFC9293](#)].


```
<CODE BEGINS> file "ietf-tcp-common@2024-02-22.yang"
```

```
module ietf-tcp-common {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-tcp-common";
  prefix tcpcmn;

  organization
    "IETF NETCONF (Network Configuration) Working Group and the
     IETF TCP Maintenance and Minor Extensions (TCPM) Working Group";

  contact
    "WG Web:   https://datatracker.ietf.org/wg/netconf
              https://datatracker.ietf.org/wg/tcpm
    WG List:  NETCONF WG list <mailto:netconf@ietf.org>
              TCPM WG list <mailto:tcpm@ietf.org>
    Authors:  Kent Watsen <mailto:kent+ietf@watsen.net>
              Michael Scharf
              <mailto:michael.scharf@hs-esslingen.de>";

  description
    "This module define a reusable 'grouping' that is common
     to both TCP-clients and TCP-servers. This grouping statement
     is used by both the 'ietf-tcp-client' and 'ietf-tcp-server'
     modules.

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

     This version of this YANG module is part of RFC DDDD
     (https://www.rfc-editor.org/info/rfcDDDD); see the RFC
     itself for full legal notices.

     The key words 'MUST', 'MUST NOT', 'REQUIRED', 'SHALL',
     'SHALL NOT', 'SHOULD', 'SHOULD NOT', 'RECOMMENDED',
     'NOT RECOMMENDED', 'MAY', and 'OPTIONAL' in this document
     are to be interpreted as described in BCP 14 (RFC 2119)
     (RFC 8174) when, and only when, they appear in all
     capitals, as shown here.";

  revision 2024-02-22 {
    description
      "Initial version";
    reference
      "RFC DDDD: YANG Groupings for TCP Clients and TCP Servers";
```

```

}

// Features

feature keepalives-supported {
    description
        "Indicates that keepalives are supported.";
}

// Groupings

grouping tcp-common-grouping {
    description
        "A reusable grouping for configuring TCP parameters common
        to TCP connections as well as the operating system as a
        whole.";
    container keepalives {
        if-feature "keepalives-supported";
        presence
            "Indicates that keepalives are enabled, aligning to
            the requirement in Section 3.8.4 RFC 9293 that
            keepalives are off by default.";
        description
            "Configures the keep-alive policy, to proactively test the
            aliveness of the TCP peer. An unresponsive TCP peer is
            dropped after approximately (idle-time + max-probes *
            probe-interval) seconds. Further guidance can be found
            in Section 2.1.5 of RFC DDDD.";
        reference
            "RFC 9293: Transmission Control Protocol (TCP)";
        leaf idle-time {
            type uint16 {
                range "1..max";
            }
            units "seconds";
            default 7200;
            description
                "Sets the amount of time after which if no data has been
                received from the TCP peer, a TCP-level probe message
                will be sent to test the aliveness of the TCP peer.
                Two hours (7200 seconds) is safe value, per RFC 9293
                Section 3.8.4.";
            reference
                "RFC 9293: Transmission Control Protocol (TCP)";
        }
        leaf max-probes {
            type uint16 {
                range "1..max";
            }
        }
    }
}

```

```

    }
    default 9;
    description
        "Sets the maximum number of sequential keep-alive probes
         that can fail to obtain a response from the TCP peer
         before assuming the TCP peer is no longer alive.";
    }
    leaf probe-interval {
        type uint16 {
            range "1..max";
        }
        units "seconds";
        default 75;
        description
            "Sets the time interval between failed probes. The interval
             SHOULD be significantly longer than one second in order to
             avoid harm on a congested link.";
    }
} // container keepalives
} // grouping tcp-common-grouping
}

<CODE ENDS>

```

3. The "ietf-tcp-client" Module

This section defines a YANG 1.1 module called "ietf-tcp-client". A high-level overview of the module is provided in [Section 3.1](#). Examples illustrating the module's use are provided in [Examples \(Section 3.2\)](#). The YANG module itself is defined in [Section 3.3](#).

3.1. Data Model Overview

This section provides an overview of the "ietf-tcp-client" module in terms of its features and groupings.

3.1.1. Features

The following diagram lists all the "feature" statements defined in the "ietf-tcp-client" module:

Features:

```
+-- local-binding-supported
+-- tcp-client-keepalives
+-- proxy-connect
    +-- socks4-supported {proxy-connect}?
    +-- socks4a-supported {proxy-connect}?
    +-- socks5-supported {proxy-connect}?
        +-- socks5-gss-api {socks5-supported}?
        +-- socks5-username-password {socks5-supported}?
```

Comments:

*The "local-binding-supported" feature indicates that the server supports configuring local bindings (i.e., the local address and local port) for TCP clients."

*The "tcp-client-keepalives" feature indicates that per socket TCP keepalive parameters are configurable for TCP clients on the server implementing this feature.

*The "proxy-connect" feature indicates the TCP-client supports connecting through TCP proxies.

*The "socks4-supported" feature indicates the TCP-client supports Socks4-based proxies.

*The "socks4a-supported" feature indicates the TCP-client supports Socks4a-based proxies. The difference between Socks4 and Socks4a is that Socks4a enables the "remote-address" to be specified using a hostname, in addition to an IP address.

*The "socks5-supported" feature indicates the TCP-client supports Socks5-based proxies.

*The "socks5-gss-api" feature indicates that the server, when acting as a TCP-client, supports authenticating to a SOCKS Version 5 proxy server using GSSAPI credentials.

*The "socks5-username-password" feature indicates that the server, when acting as a TCP-client, supports authenticating to a SOCKS Version 5 proxy server using 'username' and 'password' credentials."

The diagram above uses syntax that is similar to but not defined in [[RFC8340](#)].

3.1.2. Groupings

The "ietf-tcp-client" module defines the following "grouping" statement:

```
*tcp-client-grouping
```

This grouping is presented in the following subsection.

3.1.2.1. The "tcp-client-grouping" Grouping

The following tree diagram [[RFC8340](#)] illustrates the "tcp-client-grouping" grouping:

```
grouping tcp-client-grouping:
  +-- remote-address          inet:host
  +-- remote-port?          inet:port-number
  +-- local-address?        inet:ip-address
  |   {local-binding-supported}?
  +-- local-port?          inet:port-number
  |   {local-binding-supported}?
  +-- proxy-server! {proxy-connect}?
  |   +-- (proxy-type)
  |   |   +--:(socks4) {socks4-supported}?
  |   |   |   +-- socks4-parameters
  |   |   |   |   +-- remote-address    inet:ip-address
  |   |   |   |   +-- remote-port?    inet:port-number
  |   |   |   +--:(socks4a) {socks4a-supported}?
  |   |   |   |   +-- socks4a-parameters
  |   |   |   |   |   +-- remote-address    inet:host
  |   |   |   |   |   +-- remote-port?    inet:port-number
  |   |   |   +--:(socks5) {socks5-supported}?
  |   |   |   |   +-- socks5-parameters
  |   |   |   |   |   +-- remote-address    inet:host
  |   |   |   |   |   +-- remote-port?    inet:port-number
  |   |   |   |   |   +-- authentication-parameters!
  |   |   |   |   |   |   +-- (auth-type)
  |   |   |   |   |   |   |   +--:(gss-api) {socks5-gss-api}?
  |   |   |   |   |   |   |   |   +-- gss-api
  |   |   |   |   |   |   |   +--:(username-password)
  |   |   |   |   |   |   |   |   {socks5-username-password}?
  |   |   |   |   |   |   |   |   +-- username-password
  |   |   |   |   |   |   |   |   |   +-- username          string
  |   |   |   |   |   |   |   |   |   +---u ct:password-grouping
  +---u tcpcmn:tcp-common-grouping
```

Comments:

*The "remote-address" node, which is mandatory, may be configured as an IPv4 address, an IPv6 address, or a hostname.

*The "remote-port" node is not mandatory, but its default value is the invalid value '0', thus forcing the consuming data model to refine it in order to provide it an appropriate default value.

*The "local-address" node, which is enabled by the "local-binding-supported" feature ([Section 2.1.2](#)), may be configured as an IPv4 address, an IPv6 address, or a wildcard value.

*The "local-port" node, which is enabled by the "local-binding-supported" feature ([Section 2.1.2](#)), is not mandatory. Its default value is '0', indicating that the operating system can pick an arbitrary port number.

*The "proxy-server" node is enabled by a "feature" statement and, for servers that enable it, is a "presence" container so that the descendant "mandatory true" choice node does not imply that the proxy-server node must be configured. The proxy-server node uses a "choice" statement to allow one of several types of proxies to be configured. The choices presented in this document include Socks4, Socks4a, and Socks5, each enabled by a YANG feature (see [Section 3.1.1](#)). Other proxy types may be added by future work.

*This grouping uses the "password-grouping" grouping discussed in [[I-D.ietf-netconf-crypto-types](#)].

*This grouping uses the "tcp-common-grouping" grouping discussed in [Section 2.1.3.1](#).

3.1.3. Protocol-accessible Nodes

The "ietf-tcp-client" module defines only "grouping" statements that are used by other modules to instantiate protocol-accessible nodes. Thus this module, when implemented, does not itself define any protocol-accessible nodes.

3.2. Example Usage

This section presents two examples showing the "tcp-client-grouping" populated with some data. This example shows a TCP-client configured to not connect via a proxy:

```

<!-- The outermost element below doesn't exist in the data model. -->
<!-- It simulates if the "grouping" were a "container" instead. -->

<tcp-client xmlns="urn:ietf:params:xml:ns:yang:ietf-tcp-client">
  <remote-address>www.example.com</remote-address>
  <remote-port>8443</remote-port>
  <local-address>192.0.2.2</local-address>
  <local-port>12345</local-port>
  <keepalives>
    <idle-time>7200</idle-time>
    <max-probes>9</max-probes>
    <probe-interval>75</probe-interval>
  </keepalives>
</tcp-client>

```

This example shows a TCP-client configured to connect via a proxy:

```

<!-- The outermost element below doesn't exist in the data model. -->
<!-- It simulates if the "grouping" were a "container" instead. -->

<tcp-client xmlns="urn:ietf:params:xml:ns:yang:ietf-tcp-client">
  <remote-address>www.example.com</remote-address>
  <remote-port>8443</remote-port>
  <local-address>192.0.2.2</local-address>
  <local-port>12345</local-port>
  <proxy-server>
    <socks5-parameters>
      <remote-address>proxy.example.com</remote-address>
      <remote-port>1080</remote-port>
      <authentication-parameters>
        <username-password>
          <username>foobar</username>
          <cleartext-password>secret</cleartext-password>
        </username-password>
      </authentication-parameters>
    </socks5-parameters>
  </proxy-server>
  <keepalives>
    <idle-time>7200</idle-time>
    <max-probes>9</max-probes>
    <probe-interval>75</probe-interval>
  </keepalives>
</tcp-client>

```

3.3. YANG Module

The ietf-tcp-client YANG module references [[SOCKS 4A](#)], [[RFC1928](#)], [[RFC1929](#)], [[RFC2743](#)], [[RFC6991](#)], [[RFC9293](#)], and [[I-D.ietf-netconf-crypto-types](#)].


```
<CODE BEGINS> file "ietf-tcp-client@2024-02-22.yang"
```

```
module ietf-tcp-client {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-tcp-client";
  prefix tcpc;

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

  import ietf-crypto-types {
    prefix ct;
    reference
      "RFC AAAA: YANG Data Types and Groupings for Cryptography";
  }

  import ietf-tcp-common {
    prefix tcpcmn;
    reference
      "RFC DDDD: YANG Groupings for TCP Clients and TCP Servers";
  }

  organization
    "IETF NETCONF (Network Configuration) Working Group and the
     IETF TCP Maintenance and Minor Extensions (TCPM) Working Group";

  contact
    "WG Web:   https://datatracker.ietf.org/wg/netconf
              https://datatracker.ietf.org/wg/tcpm
    WG List:  NETCONF WG list <mailto:netconf@ietf.org>
              TCPM WG list <mailto:tcpm@ietf.org>
    Authors:  Kent Watsen <mailto:kent+ietf@watsen.net>
              Michael Scharf
              <mailto:michael.scharf@hs-esslingen.de>";

  description
    "This module defines reusable groupings for TCP clients that
     can be used as a basis for specific TCP client instances.

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     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 DDDD (<https://www.rfc-editor.org/info/rfcDDDD>); see the RFC itself for full legal notices.

The key words 'MUST', 'MUST NOT', 'REQUIRED', 'SHALL', 'SHALL NOT', 'SHOULD', 'SHOULD NOT', 'RECOMMENDED', 'NOT RECOMMENDED', 'MAY', and 'OPTIONAL' in this document are to be interpreted as described in BCP 14 (RFC 2119) (RFC 8174) when, and only when, they appear in all capitals, as shown here.";

```
revision 2024-02-22 {
  description
    "Initial version";
  reference
    "RFC DDDD: YANG Groupings for TCP Clients and TCP Servers";
}

// Features

feature local-binding-supported {
  description
    "Indicates that the server supports configuring local
    bindings (i.e., the local address and local port) for
    TCP clients.";
}

feature tcp-client-keepalives {
  description
    "Per socket TCP keepalive parameters are configurable for
    TCP clients on the server implementing this feature.";
  reference
    "RFC 9293: Transmission Control Protocol (TCP)";
}

feature proxy-connect {
  description
    "Indicates the TCP-client supports connecting through
    TCP proxies.";
}

feature socks4-supported {
  if-feature proxy-connect;
  description
    "Indicates the TCP-client supports Socks4-based proxies.";
  reference
    "SOCKS Proceedings:
    1992 Usenix Security Symposium.";
}
```

```

feature socks4a-supported {
  if-feature proxy-connect;
  description
    "Indicates the TCP-client supports Socks4a-based proxies.";
  reference
    "OpenSSH message:
     SOCKS 4A: A Simple Extension to SOCKS 4 Protocol
     https://www.openssh.com/txt/socks4a.protocol.";
}

feature socks5-supported {
  if-feature proxy-connect;
  description
    "Indicates the TCP-client supports Socks5-based proxies.";
  reference
    "RFC 1928:
     SOCKS Protocol Version 5";
}

feature socks5-gss-api {
  if-feature socks5-supported;
  description
    "Indicates that the server, when acting as a TCP-client,
     supports authenticating to a SOCKS Version 5 proxy server
     using GSSAPI credentials.";
  reference
    "RFC 1928: SOCKS Protocol Version 5";
}

feature socks5-username-password {
  if-feature socks5-supported;
  description
    "Indicates that the server, when acting as a TCP-client,
     supports authenticating to a SOCKS Version 5 proxy server
     using 'username' and 'password' credentials.";
  reference
    "RFC 1928: SOCKS Protocol Version 5";
}

// Groupings

grouping tcp-client-grouping {
  description
    "A reusable grouping for configuring a TCP client.

    Note that this grouping uses fairly typical descendant
    node names such that a stack of 'uses' statements will
    have name conflicts. It is intended that the consuming
    data model will resolve the issue (e.g., by wrapping
  
```

the 'uses' statement in a container called 'tcp-client-parameters'). This model purposely does not do this itself so as to provide maximum flexibility to consuming models.";

```
leaf remote-address {
  type inet:host;
  mandatory true;
  description
    "The IP address or hostname of the remote peer to
    establish a connection with. If a domain name is
    configured, then the DNS resolution should happen on
    each connection attempt. If the DNS resolution
    results in multiple IP addresses, the IP addresses
    are tried according to local preference order until
    a connection has been established or until all IP
    addresses have failed.";
}
leaf remote-port {
  type inet:port-number;
  default "0";
  description
    "The IP port number for the remote peer to establish a
    connection with. An invalid default value is used
    so that importing modules may 'refine' it with the
    appropriate default port number value.";
}
leaf local-address {
  if-feature "local-binding-supported";
  type inet:ip-address;
  description
    "The local IP address/interface to bind to for when
    connecting to the remote peer. INADDR_ANY ('0.0.0.0') or
    INADDR6_ANY ('0:0:0:0:0:0:0:0' a.k.a. '::') MAY be used to
    explicitly indicate the implicit default, that the server
    can bind to any IPv4 or IPv6 address.";
}
leaf local-port {
  if-feature "local-binding-supported";
  type inet:port-number;
  default "0";
  description
    "The local IP port number to bind to for when connecting
    to the remote peer. The port number '0', which is the
    default value, indicates that any available local port
    number may be used.";
}
container proxy-server {
  if-feature "proxy-connect";
```

```

presence
  "Indicates that a proxy connection has been configured.
  Present so that the mandatory descendant nodes do not
  imply that this node must be configured.";
choice proxy-type {
  mandatory true;
  description
    "Selects a proxy connection protocol.";
  case socks4 {
    if-feature socks4-supported;
    container socks4-parameters {
      leaf remote-address {
        type inet:ip-address;
        mandatory true;
        description
          "The IP address of the proxy server.";
      }
      leaf remote-port {
        type inet:port-number;
        default "1080";
        description
          "The IP port number for the proxy server.";
      }
    }
    description
      "Parameters for connecting to a TCP-based proxy
      server using the SOCKS4 protocol.";
    reference
      "SOCKS, Proceedings: 1992 Usenix Security Symposium.";
  }
}
case socks4a {
  if-feature socks4a-supported;
  container socks4a-parameters {
    leaf remote-address {
      type inet:host;
      mandatory true;
      description
        "The IP address or hostname of the proxy server.";
    }
    leaf remote-port {
      type inet:port-number;
      default "1080";
      description
        "The IP port number for the proxy server.";
    }
  }
  description
    "Parameters for connecting to a TCP-based proxy
    server using the SOCKS4a protocol.";
  reference

```

```

    "SOCKS Proceedings:
      1992 Usenix Security Symposium.
    OpenSSH message:
      SOCKS 4A: A Simple Extension to SOCKS 4 Protocol
      https://www.openssh.com/txt/socks4a.protocol";
  }
}
case socks5 {
  if-feature socks5-supported;
  container socks5-parameters {
    leaf remote-address {
      type inet:host;
      mandatory true;
      description
        "The IP address or hostname of the proxy server.";
    }
    leaf remote-port {
      type inet:port-number;
      default "1080";
      description
        "The IP port number for the proxy server.";
    }
  }
  container authentication-parameters {
    presence
      "Indicates that an authentication mechanism
      has been configured. Present so that the
      mandatory descendant nodes do not imply that
      this node must be configured.";
    description
      "A container for SOCKS Version 5 authentication
      mechanisms.

      A complete list of methods is defined at:
      https://www.iana.org/assignments/socks-methods
      /socks-methods.xhtml.";
    reference
      "RFC 1928: SOCKS Protocol Version 5";
    choice auth-type {
      mandatory true;
      description
        "A choice amongst supported SOCKS Version 5
        authentication mechanisms.";
      case gss-api {
        if-feature "socks5-gss-api";
        container gss-api {
          description
            "Contains GSS-API configuration. Defines
            as an empty container to enable specific
            GSS-API configuration to be augmented in

```

```

        by future modules.";
reference
    "RFC 1928: SOCKS Protocol Version 5
    RFC 2743: Generic Security Service
        Application Program Interface
        Version 2, Update 1";
    }
}
case username-password {
    if-feature "socks5-username-password";
    container username-password {
        leaf username {
            type string;
            mandatory true;
            description
                "The 'username' value to use for client
                identification.";
        }
        uses ct:password-grouping {
            description
                "The password to be used for client
                authentication.";
        }
        description
            "Contains Username/Password configuration.";
        reference
            "RFC 1929: Username/Password Authentication
            for SOCKS V5";
    }
}
}
}
description
    "Parameters for connecting to a TCP-based proxy server
    using the SOCKS5 protocol.";
reference
    "RFC 1928: SOCKS Protocol Version 5";
}
}
}
description
    "Proxy server settings.";
}

uses tcpcmn:tcp-common-grouping {
    refine "keepalives" {
        if-feature "tcp-client-keepalives";
        description
            "An if-feature statement so that implementations

```



```
        can choose to support TCP client keepalives.";
    }
}
}
```

<CODE ENDS>

4. The "ietf-tcp-server" Module

This section defines a YANG 1.1 module called "ietf-tcp-server". A high-level overview of the module is provided in [Section 4.1](#). Examples illustrating the module's use are provided in [Examples \(Section 4.2\)](#). The YANG module itself is defined in [Section 4.3](#).

4.1. Data Model Overview

This section provides an overview of the "ietf-tcp-server" module in terms of its features and groupings.

4.1.1. Features

The following diagram lists all the "feature" statements defined in the "ietf-tcp-server" module:

Features:

```
+-- tcp-server-keepalives
```

The diagram above uses syntax that is similar to but not defined in [\[RFC8340\]](#).

4.1.2. Groupings

The "ietf-tcp-server" module defines the following "grouping" statement:

```
*tcp-server-grouping
```

This grouping is presented in the following subsection.

4.1.2.1. The "tcp-server-grouping" Grouping

The following tree diagram [\[RFC8340\]](#) illustrates the "tcp-server-grouping" grouping:

```
grouping tcp-server-grouping:
  +-- local-address          inet:ip-address
  +-- local-port?           inet:port-number
  +---u tcpcmn:tcp-common-grouping
```

Comments:

*The "local-address" node, which is mandatory, may be configured as an IPv4 address, an IPv6 address, or a wildcard value.

*The "local-port" node is not mandatory, but its default value is the invalid value '0', thus forcing the consuming data model to refine it in order to provide it an appropriate default value.

*This grouping uses the "tcp-common-grouping" grouping discussed in [Section 2.1.3.1](#).

4.1.3. Protocol-accessible Nodes

The "ietf-tcp-server" module defines only "grouping" statements that are used by other modules to instantiate protocol-accessible nodes. Thus this module, when implemented, does not itself define any protocol-accessible nodes.

4.2. Example Usage

This section presents an example showing the "tcp-server-grouping" populated with some data.

```
<!-- The outermost element below doesn't exist in the data model. -->
<!-- It simulates if the "grouping" were a "container" instead. -->

<tcp-server xmlns="urn:ietf:params:xml:ns:yang:ietf-tcp-server">
  <local-address>192.0.2.2</local-address>
  <local-port>49152</local-port>
  <keepalives>
    <idle-time>7200</idle-time>
    <max-probes>9</max-probes>
    <probe-interval>75</probe-interval>
  </keepalives>
</tcp-server>
```

4.3. YANG Module

The ietf-tcp-server YANG module references [[RFC6991](#)] and [[RFC9293](#)].

```
<CODE BEGINS> file "ietf-tcp-server@2024-02-22.yang"
```

```
module ietf-tcp-server {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-tcp-server";
  prefix tcps;

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

  import ietf-tcp-common {
    prefix tcpcmn;
    reference
      "RFC DDDD: YANG Groupings for TCP Clients and TCP Servers";
  }

  organization
    "IETF NETCONF (Network Configuration) Working Group and the
     IETF TCP Maintenance and Minor Extensions (TCPM) Working Group";

  contact
    "WG Web:   https://datatracker.ietf.org/wg/netconf
     https://datatracker.ietf.org/wg/tcpm
     WG List:  NETCONF WG list <mailto:netconf@ietf.org>
     TCPM WG list <mailto:tcpm@ietf.org>
     Authors:  Kent Watsen <mailto:kent+ietf@watsen.net>
     Michael Scharf
     <mailto:michael.scharf@hs-esslingen.de>;"

  description
    "This module defines reusable groupings for TCP servers that
     can be used as a basis for specific TCP server instances.

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     (https://trustee.ietf.org/license-info)."

    This version of this YANG module is part of RFC DDDD
    (https://www.rfc-editor.org/info/rfcDDDD); see the RFC
    itself for full legal notices.

    The key words 'MUST', 'MUST NOT', 'REQUIRED', 'SHALL',
    'SHALL NOT', 'SHOULD', 'SHOULD NOT', 'RECOMMENDED',
```

'NOT RECOMMENDED', 'MAY', and 'OPTIONAL' in this document are to be interpreted as described in BCP 14 (RFC 2119) (RFC 8174) when, and only when, they appear in all capitals, as shown here.";

```
revision 2024-02-22 {  
  description  
    "Initial version";  
  reference  
    "RFC DDDD: YANG Groupings for TCP Clients and TCP Servers";  
}
```

// Features

```
feature tcp-server-keepalives {  
  description  
    "Per socket TCP keepalive parameters are configurable for  
    TCP servers on the server implementing this feature.";  
  reference  
    "RFC 9293: Transmission Control Protocol (TCP)";  
}
```

// Groupings

```
grouping tcp-server-grouping {  
  description  
    "A reusable grouping for configuring a TCP server.  
  
    Note that this grouping uses fairly typical descendant  
    node names such that a stack of 'uses' statements will  
    have name conflicts. It is intended that the consuming  
    data model will resolve the issue (e.g., by wrapping  
    the 'uses' statement in a container called  
    'tcp-server-parameters'). This model purposely does  
    not do this itself so as to provide maximum flexibility  
    to consuming models.";  
  leaf local-address {  
    type inet:ip-address;  
    mandatory true;  
    description  
      "The local IP address to listen on for incoming  
      TCP client connections. INADDR_ANY (0.0.0.0) or  
      INADDR6_ANY (0:0:0:0:0:0:0:0 a.k.a. ::) MUST be  
      used when the server is to listen on all IPv4 or  
      IPv6 address.";  
  }  
  leaf local-port {  
    type inet:port-number;  
    default "0";  
  }  
}
```

```

description
  "The local port number to listen on for incoming TCP
  client connections.  An invalid default value (0)
  is used (instead of 'mandatory true') so that an
  application level data model may 'refine' it with
  an application specific default port number value.";
}
uses tcpcmn:tcp-common-grouping {
  refine "keepalives" {
    if-feature "tcp-server-keepalives";
    description
      "An if-feature statement so that implementations
      can choose to support TCP server keepalives.";
  }
}
}
}

```

<CODE ENDS>

5. Security Considerations

5.1. Considerations for the "ietf-tcp-common" YANG Module

This section follows the template defined in [Section 3.7.1](#) of [\[RFC8407\]](#).

The "ietf-tcp-common" YANG module defines "grouping" statements that are 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 Network Access Control Model (NACM) [\[RFC8341\]](#) provides the means to restrict access for particular users to a pre-configured subset of all available protocol operations and content.

Since the module in this document only define groupings, these considerations are primarily for the designers of other modules that use these groupings.

Please be aware that this YANG module uses groupings from other YANG modules that define nodes that may be considered sensitive or vulnerable in network environments. Please review the Security Considerations for dependent YANG modules for information as to which nodes may be considered sensitive or vulnerable in network environments.

None of the readable data nodes defined in this YANG module are considered sensitive or vulnerable in network environments. The NACM

"default-deny-all" extension has not been set for any data nodes defined in this module.

None of the writable data nodes defined in this YANG module are considered sensitive or vulnerable in network environments. The NACM "default-deny-write" extension has not been set for any data nodes defined in this module.

This module does not define any RPCs, actions, or notifications, and thus the security consideration for such is not provided here.

5.2. Considerations for the "ietf-tcp-client" YANG Module

This section follows the template defined in [Section 3.7.1](#) of [\[RFC8407\]](#).

The "ietf-tcp-client" YANG module defines "grouping" statements that are 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 Network Access Control Model (NACM) [\[RFC8341\]](#) provides the means to restrict access for particular users to a pre-configured subset of all available protocol operations and content.

Since the module in this document only define groupings, these considerations are primarily for the designers of other modules that use these groupings.

Please be aware that this YANG module uses groupings from other YANG modules that define nodes that may be considered sensitive or vulnerable in network environments. Please review the Security Considerations for dependent YANG modules for information as to which nodes may be considered sensitive or vulnerable in network environments.

One readable data node defined in this YANG module may be considered sensitive or vulnerable in some network environments. This node is as follows:

*The "proxy-server/socks5-parameters/authentication-parameters/username-password/password" node:

The "password" node defined in the "tcp-client-grouping" grouping is defined using the "password-grouping" grouping presented in [\[I-D.ietf-netconf-crypto-types\]](#). This grouping enables both cleartext and encrypted passwords to be configured. As the referenced document states, configuration of cleartext passwords is NOT RECOMMENDED. However, in the

case cleartext values are configured, this node is additionally sensitive to read operations such that, in normal use cases, it should never be returned to a client. For this reason, the NACM extension "default-deny-all" has been applied to it.

None of the writable data nodes defined in this YANG module are considered sensitive or vulnerable in network environments. The NACM "default-deny-write" extension has not been set for any data nodes defined in this module.

This module does not define any RPCs, actions, or notifications, and thus the security consideration for such is not provided here.

Implementations are RECOMMENDED to implement the "local-binding-supported" feature for cryptographically-secure protocols, so as to enable more granular ingress/egress firewall rulebases. It is NOT RECOMMENDED to implement this feature for unsecure protocols, as per [[RFC6056](#)].

5.3. Considerations for the "ietf-tcp-server" YANG Module

This section follows the template defined in [Section 3.7.1](#) of [[RFC8407](#)].

The "ietf-tcp-server" YANG module defines "grouping" statements that are 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 Network Access Control Model (NACM) [[RFC8341](#)] provides the means to restrict access for particular users to a pre-configured subset of all available protocol operations and content.

Since the module in this document only define groupings, these considerations are primarily for the designers of other modules that use these groupings.

Please be aware that this YANG module uses groupings from other YANG modules that define nodes that may be considered sensitive or vulnerable in network environments. Please review the Security Considerations for dependent YANG modules for information as to which nodes may be considered sensitive or vulnerable in network environments.

None of the readable data nodes defined in this YANG module are considered sensitive or vulnerable in network environments. The NACM "default-deny-all" extension has not been set for any data nodes defined in this module.

None of the writable data nodes defined in this YANG module are considered sensitive or vulnerable in network environments. The NACM "default-deny-write" extension has not been set for any data nodes defined in this module.

This module does not define any RPCs, actions, or notifications, and thus the security consideration for such is not provided here.

6. IANA Considerations

6.1. The "IETF XML" Registry

This document registers three URIs in the "ns" subregistry of the IETF XML Registry [[RFC3688](#)]. Following the format in [[RFC3688](#)], the following registrations are requested:

URI: urn:ietf:params:xml:ns:yang:ietf-tcp-common
Registrant Contact: The IESG
XML: N/A, the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-tcp-client
Registrant Contact: The IESG
XML: N/A, the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-tcp-server
Registrant Contact: The IESG
XML: N/A, the requested URI is an XML namespace.

6.2. The "YANG Module Names" Registry

This document registers three YANG modules in the YANG Module Names registry [[RFC6020](#)]. Following the format in [[RFC6020](#)], the following registrations are requested:

name: ietf-tcp-common
namespace: urn:ietf:params:xml:ns:yang:ietf-tcp-common
prefix: tcpcmn
reference: RFC DDDD

name: ietf-tcp-client
namespace: urn:ietf:params:xml:ns:yang:ietf-tcp-client
prefix: tcpc
reference: RFC DDDD

name: ietf-tcp-server
namespace: urn:ietf:params:xml:ns:yang:ietf-tcp-server
prefix: tcps
reference: RFC DDDD

7. References

7.1. Normative References

[I-D.ietf-netconf-crypto-types]

Watsen, K., "YANG Data Types and Groupings for Cryptography", Work in Progress, Internet-Draft, draft-ietf-netconf-crypto-types-31, 8 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-crypto-types-31>>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.

[RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, DOI 10.17487/RFC6020, October 2010, <<https://www.rfc-editor.org/info/rfc6020>>.

[RFC6991] Schoenwaelder, J., Ed., "Common YANG Data Types", RFC 6991, DOI 10.17487/RFC6991, July 2013, <<https://www.rfc-editor.org/info/rfc6991>>.

[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>>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.

[RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, RFC 8341, DOI 10.17487/RFC8341, March 2018, <<https://www.rfc-editor.org/info/rfc8341>>.

[RFC9293] Eddy, W., Ed., "Transmission Control Protocol (TCP)", STD 7, RFC 9293, DOI 10.17487/RFC9293, August 2022, <<https://www.rfc-editor.org/info/rfc9293>>.

7.2. Informative References

[I-D.ietf-netconf-http-client-server]

Watsen, K., "YANG Groupings for HTTP 1.1/2.0 Clients and HTTP Servers", Work in Progress, Internet-Draft, draft-ietf-netconf-http-client-server-17, 8 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-http-client-server-17>>.

[I-D.ietf-netconf-keystore]

Watsen, K., "A YANG Data Model for a Keystore and Keystore Operations", Work in Progress, Internet-Draft, draft-ietf-netconf-keystore-32, 8 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-keystore-32>>.

[I-D.ietf-netconf-netconf-client-server]

Watsen, K., "NETCONF Client and Server Models", Work in Progress, Internet-Draft, draft-ietf-netconf-netconf-client-server-33, 8 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-netconf-client-server-33>>.

[I-D.ietf-netconf-restconf-client-server]

Watsen, K., "RESTCONF Client and Server Models", Work in Progress, Internet-Draft, draft-ietf-netconf-restconf-client-server-33, 9 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-restconf-client-server-33>>.

[I-D.ietf-netconf-ssh-client-server]

Watsen, K., "YANG Groupings for SSH Clients and SSH Servers", Work in Progress, Internet-Draft, draft-ietf-netconf-ssh-client-server-37, 8 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-ssh-client-server-37>>.

[I-D.ietf-netconf-tcp-client-server] Watsen, K. and M. Scharf, "YANG Groupings for TCP Clients and TCP Servers", Work in Progress, Internet-Draft, draft-ietf-netconf-tcp-client-server-21, 8 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-tcp-client-server-21>>.

[I-D.ietf-netconf-tls-client-server]

Watsen, K., "YANG Groupings for TLS Clients and TLS Servers", Work in Progress, Internet-Draft, draft-ietf-netconf-tls-client-server-38, 8 February 2024, <<https://datatracker.ietf.org/doc/html/draft-ietf-netconf-tls-client-server-38>>.

[I-D.ietf-netconf-trust-anchors]

Watsen, K., "A YANG Data Model for a Truststore", Work in Progress, Internet-Draft, draft-ietf-netconf-trust-anchors-25, 8 February 2024, <<https://>>

datatracker.ietf.org/doc/html/draft-ietf-netconf-trust-anchors-25>.

- [RFC1928] Leech, M., Ganis, M., Lee, Y., Kuris, R., Koblas, D., and L. Jones, "SOCKS Protocol Version 5", RFC 1928, DOI 10.17487/RFC1928, March 1996, <<https://www.rfc-editor.org/info/rfc1928>>.
- [RFC1929] Leech, M., "Username/Password Authentication for SOCKS V5", RFC 1929, DOI 10.17487/RFC1929, March 1996, <<https://www.rfc-editor.org/info/rfc1929>>.
- [RFC2743] Linn, J., "Generic Security Service Application Program Interface Version 2, Update 1", RFC 2743, DOI 10.17487/RFC2743, January 2000, <<https://www.rfc-editor.org/info/rfc2743>>.
- [RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, DOI 10.17487/RFC3688, January 2004, <<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC6056] Larsen, M. and F. Gont, "Recommendations for Transport-Protocol Port Randomization", BCP 156, RFC 6056, DOI 10.17487/RFC6056, January 2011, <<https://www.rfc-editor.org/info/rfc6056>>.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <<https://www.rfc-editor.org/info/rfc8040>>.
- [RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", BCP 215, RFC 8340, DOI 10.17487/RFC8340, March 2018, <<https://www.rfc-editor.org/info/rfc8340>>.
- [RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "Network Management Datastore Architecture (NMDA)", RFC 8342, DOI 10.17487/RFC8342, March 2018, <<https://www.rfc-editor.org/info/rfc8342>>.
- [RFC8407] Bierman, A., "Guidelines for Authors and Reviewers of Documents Containing YANG Data Models", BCP 216, RFC

8407, DOI 10.17487/RFC8407, October 2018, <<https://www.rfc-editor.org/info/rfc8407>>.

[SOCKS_4A] Project, T. O., "SOCKS 4A: A Simple Extension to SOCKS 4 Protocol", <<https://www.openssh.com/txt/socks4a.protocol>>.

Appendix A. Change Log

A.1. 00 to 01

*Added 'local-binding-supported' feature to TCP-client model.

*Added 'keepalives-supported' feature to TCP-common model.

*Added 'external-endpoint-values' container and 'external-endpoints' feature to TCP-server model.

A.2. 01 to 02

*Removed the 'external-endpoint-values' container and 'external-endpoints' feature from the TCP-server model.

A.3. 02 to 03

*Moved the common model section to be before the client and server specific sections.

*Added sections "Model Scope" and "Usage Guidelines for Configuring TCP Keep-Alives" to the common model section.

A.4. 03 to 04

*Fixed a few typos.

A.5. 04 to 05

*Removed commented out "grouping tcp-system-grouping" statement kept for reviewers.

*Added a "Note to Reviewers" note to first page.

A.6. 05 to 06

*Added support for TCP proxies.

A.7. 06 to 07

*Expanded "Data Model Overview section(s) [remove "wall" of tree diagrams].

*Updated the Security Considerations section.

A.8. 07 to 08

*Added missing IANA registration for "ietf-tcp-common"

*Added "mandatory true" for the "username" and "password" leafs

*Added an example of a TCP-client configured to connect via a proxy

*Fixed issues found by the SecDir review of the "keystore" draft.

*Updated the "ietf-tcp-client" module to use the new "password-grouping" grouping from the "crypto-types" module.

A.9. 08 to 09

*Addressed comments raised by YANG Doctor in the ct/ts/ks drafts.

A.10. 09 to 10

*Updated Abstract and Intro to address comments by Tom Petch.

*Removed the "tcp-connection-grouping" grouping (now models use the "tcp-common-grouping" directly).

*Added XML-comment above examples explaining the reason for the unusual top-most element's presence.

*Added Security Considerations section for the "local-binding-supported" feature.

*Replaced some hardcoded refs to <xref> elements.

*Fixed nits found by YANG Doctor reviews.

*Aligned modules with `pyang -f` formatting.

*Added an "Acknowledgements" section.

A.11. 10 to 11

*Replaced "base64encodedvalue==" with "BASE64VALUE=" in examples.

*Minor editorial nits

A.12. 11 to 12

*Fixed up the 'WG Web' and 'WG List' lines in YANG module(s)

*Fixed up copyright (i.e., s/Simplified/Revised/) in YANG module(s)

A.13. 12 to 13

*NO UPDATE.

A.14. 13 to 14

*Updated per Shepherd reviews impacting the suite of drafts.

A.15. 14 to 15

*Updated per Shepherd reviews impacting the suite of drafts.

A.16. 15 to 16

*Updated per Tom Petch review.

*Added refs to RFC9293 and SOCKS 4A.

*Fixed examples to use IETF-sanctioned values for examples.

A.17. 16 to 17

*Addresses AD review comments.

*Added note to Editor to fix line foldings.

*Added Security Considerations text to also look a SC-section from imported modules.

*Fixed bug: s/augment "keepalives"/refine "keepalives"/

*Set defaults for idle-time, max-probes, and probe-interval (removed "mandatory true").

*Updated examples to use IETF recommended values for examples.

A.18. 18 to 19

*Addresses AD review by Rob Wilton.

A.19. 18 to 19

*Replace RFC 1122 with RFC 9293.

A.20. 19 to 20

*Addresses 1st-round of IESG reviews.

A.21. 20 to 22

*Addresses issues found in OpsDir review of the ssh-client-server draft.

*Updated to address Mallory Knodel's Gen-ART review.

*Renamed Security Considerations section s/Template for/ Considerations for/

*s/defines/presents/ in a few places.

*Add refs to where the 'operational' and 'system' datastores are defined.

*Added more 'feature' statements and descriptions for them

*Added Security Consideration for the "password" node

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