Abstract

This document defines three YANG modules: the first defines groupings for a generic TLS client, the second defines groupings for a generic TLS server, and the third defines common identities and groupings used by both the client and the server. It is intended that these groupings will be used by applications using the TLS protocol.

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:

- I-D.ietf-netconf-trust-anchors
- I-D.ietf-netconf-keystore

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

- "XXXX" --> the assigned RFC value for this draft
- "YYYY" --> the assigned RFC value for I-D.ietf-netconf-trust-anchors
- "ZZZZ" --> the assigned RFC value for I-D.ietf-netconf-keystore

Artwork in this document contains placeholder values for the date of publication of this draft. Please apply the following replacement:
Internet-Draft Groupings for TLS Clients and Servers November 2019

- "2019-11-02" --> the publication date of this draft

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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This Internet-Draft will expire on May 4, 2020.

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1. Introduction

This document defines three YANG 1.1 [RFC7950] modules: the first defines a grouping for a generic TLS client, the second defines a grouping for a generic TLS server, and the third defines identities and groupings common to both the client and the server (TLS is defined in [RFC5246]). It is intended that these groupings will be used by applications using the TLS protocol. For instance, these groupings could be used to help define the data model for an HTTPS [RFC2818] server or a NETCONF over TLS [RFC7589] based server.

The client and server YANG modules in this document each define one grouping, which is focused on just TLS-specific configuration, and specifically avoids any transport-level configuration, such as what...
ports to listen-on or connect-to. This affords applications the opportunity to define their own strategy for how the underlying TCP connection is established. For instance, applications supporting NETCONF Call Home [RFC8071] could use the "ssh-server-grouping" grouping for the TLS parts it provides, while adding data nodes for the TCP-level call-home configuration.

2. Terminology

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.

3. The TLS Client Model

3.1. Tree Diagram

This section provides a tree diagram [RFC8340] for the "ietf-tls-client" module that does not have groupings expanded.

module: ietf-tls-client

    grouping tls-client-grouping
        +- client-identity
          |  +--u ks:local-or-keystore-end-entity-cert-with-key-grouping
        +- server-authentication
          |  +-- ca-certs!
          |     +--u ts:local-or-truststore-certs-grouping
          |     +-- server-certs!
          |          +-- u ts:local-or-truststore-certs-grouping
          |          +-- hello-params {tls-client-hello-params-config}?
          |              +--u tlscmn:hello-params-grouping
          |              +-- keepalives! {tls-client-keepalives}?
          |                  +-- max-wait?       uint16
          |                  +-- max-attempts?   uint8

3.2. Example Usage

This section presents two examples showing the tls-client-grouping populated with some data. These examples are effectively the same except the first configures the client identity using a local key while the second uses a key configured in a keystore. Both examples are consistent with the examples presented in Section 2 of [I-D.ietf-netconf-trust-anchors] and Section 3.2 of [I-D.ietf-netconf-keystore].
The following example configures the client identity using a local key:

```
  <!-- how this client will authenticate itself to the server -->
  <client-identity>
    <local-definition>
      <algorithm>rsa2048</algorithm>
      <public-key>base64encodedvalue==</public-key>
      <private-key>base64encodedvalue==</private-key>
      <cert>base64encodedvalue==</cert>
    </local-definition>
  </client-identity>

  <!-- which certificates will this client trust -->
  <server-authentication>
    <ca-certs>
      <truststore-reference>explicitly-trusted-server-ca-certs</truststore-reference>
    </ca-certs>
    <server-certs>
      <truststore-reference>explicitly-trusted-server-certs</truststore-reference>
    </server-certs>
  </server-authentication>

  <keepalives>
    <max-wait>30</max-wait>
    <max-attempts>3</max-attempts>
  </keepalives>
</tls-client>
```

The following example configures the client identity using a key from the keystore:
  <!-- how this client will authenticate itself to the server -->
  <client-identity>
    <keystore-reference>
      <asymmetric-key>rsa-asymmetric-key</asymmetric-key>
      <certificate>ex-rsa-cert</certificate>
    </keystore-reference>
  </client-identity>

  <!-- which certificates will this client trust -->
  <server-authentication>
    <ca-certs>
      <truststore-reference>explicitly-trusted-server-ca-certs</truststore-reference>
    </ca-certs>
    <server-certs>
      <truststore-reference>explicitly-trusted-server-certs</truststore-reference>
    </server-certs>
  </server-authentication>

  <keepalives>
    <max-wait>30</max-wait>
    <max-attempts>3</max-attempts>
  </keepalives>
</tls-client>

3.3. YANG Module

This YANG module has normative references to [I-D.ietf-netconf-trust-anchors] and [I-D.ietf-netconf-keystore].

<CODE BEGINS> file "ietf-tls-client@2019-11-02.yang"

module ietf-tls-client {
  yang-version 1.1;
  prefix tlsc;

  import ietf-tls-common {
    prefix tlscmn;
    revision-date 2019-11-02; // stable grouping definitions
    reference
      "RFC XXXX: YANG Groupings for TLS Clients and TLS Servers";

import ietf-truststore {
    prefix ts;
    reference
        "RFC YYYY: A YANG Data Model for a Truststore";
}

import ietf-keystore {
    prefix ks;
    reference
        "RFC ZZZZ: A YANG Data Model for a Keystore";
}

import ietf-netconf-acm {
    prefix nacm;
    reference
        "RFC 8341: Network Configuration Access Control Model";
}

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

contact
    "WG Web: <http://datatracker.ietf.org/wg/netconf/>
    WG List: <mailto:netconf@ietf.org>
    Author: Kent Watsen <mailto:kent+ietf@watsen.net>
    Author: Gary Wu <mailto:garywu@cisco.com>";

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

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    Legal Provisions Relating to IETF Documents

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

    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 2019-11-02 {
  description
    "Initial version";
  reference
    "RFC XXXX: YANG Groupings for TLS Clients and TLS Servers";
}

// Features

feature tls-client-hello-params-config {
  description
    "TLS hello message parameters are configurable on a TLS
    client."
}

feature tls-client-keepalives {
  description
    "Per socket TLS keepalive parameters are configurable for
    TLS clients on the server implementing this feature."
}

// Groupings

grouping tls-client-grouping {
  description
    "A reusable grouping for configuring a TLS client without
    any consideration for how an underlying TCP session is
    established.

    Note that this grouping uses fairly typical descendent
    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
    ‘tls-client-parameters’). This model purposely does
    not do this itself so as to provide maximum flexibility
to consuming models.”;
}
including any configured intermediate certificates, the
TLS client will present when establishing a TLS connection
in its Certificate message, as defined in Section 7.4.2
in RFC 5246.

reference
"RFC 5246:
The Transport Layer Security (TLS) Protocol Version 1.2
RFC ZZZZ:
YANG Data Model for a 'Keystore' Mechanism"
uses ks:local-or-keystore-end-entity-cert-with-key-grouping;
}
// container client-identity

container server-authentication {  // FIXME: what about PSKs?
  nacm:default-deny-write;
  must 'ca-certs or server-certs';
  description
  "Trusted server identities. Any combination of trusted
  server identities is additive and unordered."
  container ca-certs {
    presence
    "Indicates that the client can authenticate servers
    using the configured trust anchor certificates.";
    description
    "A set of certificate authority (CA) certificates used by
    the TLS client to authenticate TLS servers. A server
    is authenticated if its certificate has a valid chain
    of trust to a configured CA certificate.";
    uses ts:local-or-truststore-certs-grouping;
  }
  container server-certs {
    presence
    "Indicates that the client can authenticate servers
    using the configured server certificates.";
    description
    "A set of end-entity certificates used by the TLS client
    to authenticate TLS servers. A server is authenticated
    if its certificate is an exact match to a configured
    server certificate.";
    uses ts:local-or-truststore-certs-grouping;
  }
}  // container server-authentication

container hello-params {
  nacm:default-deny-write;
  if-feature "tls-client-hello-params-config";
  uses tlscmn:hello-params-grouping;
  description
  "Configurable parameters for the TLS hello message.";
4. The TLS Server Model

4.1. Tree Diagram

This section provides a tree diagram [RFC8340] for the "ietf-tls-server" module that does not have groupings expanded.
module: ietf-tls-server

grouping tls-server-grouping
  ++ server-identity
     |  +++ u:ks:local-or-keystore-end-entity-cert-with-key-grouping
     ++ client-authentication!
        |  +++ (required-or-optional)
           |     |  +++:required
           |     |  +++ required?
           |     |  +++ optional
           |  +++:optional
           |  +++ (local-or-external)
           |  +++:local {local-client-auth-supported}?
           |     |  +++ ca-certs!
           |     |     |  +++ u:ts:local-or-truststore-certs-grouping
           |     |  +++ client-certs!
           |     |     |  +++ u:ts:local-or-truststore-certs-grouping
           |     |  +++:external {external-client-auth-supported}?
           |     |     |  +++ client-auth-defined-elsewhere? empty
        |  +++ hello-params {tls-server-hello-params-config}?
           |  +++ u:tlscmn:hello-params-grouping
        ++ keepalives! {tls-server-keepalives}?
           |  +++ max-wait? uint16
           |  +++ max-attempts? uint8

4.2. Example Usage

This section presents two examples showing the tls-server-grouping populated with some data. These examples are effectively the same except the first configures the server identity using a local key while the second uses a key configured in a keystore. Both examples are consistent with the examples presented in Section 2 of [I-D.ietf-netconf-trust-anchors] and Section 3.2 of [I-D.ietf-netconf-keystore].

The following example configures the server identity using a local key:
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========== NOTE: ‘\’ line wrapping per BCP XXX (RFC XXXX) ==========

<tls-server xmlns="urn:ietf:params:xml:ns:yang:ietf-tls-server">
   <!-- how this server will authenticate itself to the client -->
   <server-identity>
      <local-definition>
         <algorithm>rsa2048</algorithm>
         <private-key>base64encodedvalue==</private-key>
         <public-key>base64encodedvalue==</public-key>
         <cert>base64encodedvalue==</cert>
      </local-definition>
   </server-identity>

   <!-- which certificates will this server trust -->
   <client-authentication>
      <required/>
      <ca-certs>
         <truststore-reference>explicitly-trusted-client-ca-certs</truststore-reference>
      </ca-certs>
      <client-certs>
         <truststore-reference>explicitly-trusted-client-certs</truststore-reference>
      </client-certs>
   </client-authentication>
</tls-server>

The following example configures the server identity using a key from the keystore:
4.3. YANG Module

This YANG module has a normative references to [RFC5246], [I-D.ietf-netconf-trust-anchors] and [I-D.ietf-netconf-keystore].

<CODE BEGINS> file "ietf-tls-server@2019-11-02.yang"

module ietf-tls-server {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-tls-server";
  prefix tlss;

  import ietf-tls-common {
    prefix tlscmn;
    revision-date 2019-11-02; // stable grouping definitions
    reference
      "RFC XXXX: YANG Groupings for TLS Clients and TLS Servers";
  }

  import ietf-truststore {
    prefix ts;
}
reference
"RFC YYYY: A YANG Data Model for a Truststore";
}

import ietf-keystore {
  prefix ks;
  reference
"RFC ZZZZ: A YANG Data Model for a Keystore";
}

import ietf-netconf-acm {
  prefix nacm;
  reference
"RFC 8341: Network Configuration Access Control Model";
}

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

contact
"WG Web: <http://datatracker.ietf.org/wg/netconf/>
WG List: <mailto:netconf@ietf.org>
Author: Kent Watsen <mailto:kent+ietf@watsen.net>
Author: Gary Wu <mailto:garywu@cisco.com>"

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

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

capitals, as shown here.

revision 2019-11-02 {
  description
    "Initial version";
  reference
    "RFC XXXX: YANG Groupings for TLS Clients and TLS Servers";
}

// Features

feature tls-server-hello-params-config {
  description
    "TLS hello message parameters are configurable on a TLS server.";
}

feature tls-server-keepalives {
  description
    "Per socket TLS keepalive parameters are configurable for TLS servers on the server implementing this feature.";
}

feature local-client-auth-supported {
  description
    "Indicates that the TLS server supports local configuration of client credentials.";
}

feature external-client-auth-supported {
  description
    "Indicates that the TLS server supports external configuration of client credentials.";
}

// Groupings

grouping tls-server-grouping {
  description
    "A reusable grouping for configuring a TLS server without any consideration for how underlying TCP sessions are established.

    Note that this grouping uses fairly typical descendent 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 ‘tls-server-parameters’). This model purposely does not do this itself so as to provide maximum flexibility to consuming models.”;

```
container server-identity {  // FIXME: what about PSKs?
  nacm:default-deny-write;
  description
    "A locally-defined or referenced end-entity certificate, including any configured intermediate certificates, the TLS server will present when establishing a TLS connection in its Certificate message, as defined in Section 7.4.2 in RFC 5246.";
  reference
    "RFC 5246:
The Transport Layer Security (TLS) Protocol Version 1.2 RFC ZZZZ:
    YANG Data Model for a 'Keystore' Mechanism";
  uses ks:local-or-keystore-end-entity-cert-with-key-grouping;
} // container server-identity
```

```
container client-authentication {  // FIXME: what about PSKs?
  nacm:default-deny-write;
  presence
    "Indicates that certificate based client authentication is supported (i.e., the server will request that the client send a certificate).";
  description
    "Specifies if TLS client authentication is required or optional, and specifies if the certificates needed to authenticate the TLS client are configured locally or externally. If configured locally, the data model enables both trust anchors and end-entity certificate to be set.";
  choice required-or-optional {
    mandatory true;  // or default to ‘required’ ?
    description
      "Indicates if TLS-level client authentication is required or optional. This is necessary for some protocols (e.g., RESTCONF) the may optionally authenticate a client via TLS-level authentication, HTTP-level authentication, or both simultaneously).";
    leaf required {
      type empty;
      description
    }
}
```
"Indicates that TLS-level client authentication is required.";

leaf optional {
  type empty;
  description
    "Indicates that TLS-level client authentication is optional.";
}

choice local-or-external {
  mandatory true;
  description
    "Indicates if the credentials needed to authenticate the clients are configured locally or externally.

    Configuring credentials externally enables applications to place client authentication with client definitions, rather than in a part of a data model principally concerned with configuring the TLS transport.";
  case local {
    if-feature "local-client-auth-supported";
    description
      "The certificates needed to authenticate the clients are configured within this TLS configuration.

      How to extract an application-level user name from the certificate is outside the scope of this data model.";
    container ca-certs {
      presence
        "Indicates that the server can authenticate clients using the configured trust anchor certificates.";
      description
        "A set of certificate authority (CA) certificates used by the TLS server to authenticate TLS clients. A client is authenticated if its certificate has a valid chain of trust to a configured CA certificate.";
      reference
        "RFC YYYY: YANG Data Model for Global Trust Anchors";
      uses ts:local-or-truststore-certs-grouping;
    }
    container client-certs {
      presence
        "Indicates that the server can authenticate clients using the configured client certificates.";
      description
        "A set of end-entity certificates used by the TLS server to authenticate TLS clients. A client is
authenticated if its certificate is an exact match to a configured client certificate.

reference

"RFC YYYY: YANG Data Model for Global Trust Anchors"
uses ts:local-or-truststore-certs-grouping;
}
}

case external {
if-feature "external-client-auth-supported";
description
"The certificates needed to authenticate the clients are configured externally."
leaf client-auth-defined-elsewhere {
type empty;
description
"Indicates that certificates needed to authenticate clients are configured elsewhere."
}
}

} // choice local-or-external
} // container client-authentication

container hello-params {
nacm:default-deny-write;
if-feature "tls-server-hello-params-config";
uses tlscmn:hello-params-grouping;
description
"Configurable parameters for the TLS hello message."
}

container keepalives {
nacm:default-deny-write;
if-feature "tls-server-keepalives";
presence "Indicates that keepalives are enabled.";
description
"Configures the keep-alive policy, to proactively test the aliveness of the TLS client. An unresponsive TLS client is dropped after approximately max-wait * max-attempts seconds."
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
The TLS common model presented in this section contains identities and groupings common to both TLS clients and TLS servers. The hello-params-grouping can be used to configure the list of TLS algorithms permitted by the TLS client or TLS server. The lists of algorithms are ordered such that, if multiple algorithms are permitted by the client, the algorithm that appears first in its list that is also permitted by the server is used for the TLS transport layer connection. The ability to restrict the algorithms allowed is provided in this grouping for TLS clients and TLS servers that are capable of doing so and may serve to make TLS clients and TLS servers compliant with local security policies. This model supports both TLS1.2 [RFC5246] and TLS 1.3 [RFC8446].

TLS 1.2 and TLS 1.3 have different ways defining their own supported cryptographic algorithms, see TLS and DTLS IANA registries page (https://www.iana.org/assignments/tls-parameters/tls-parameters.xhtml):

- TLS 1.2 defines four categories of registries for cryptographic algorithms: TLS Cipher Suites, TLS SignatureAlgorithm, TLS HashAlgorithm, TLS Supported Groups. TLS Cipher Suites plays the role of combining all of them into one set, as each value of the set represents a unique and feasible combination of all the cryptographic algorithms, and thus the other three registry categories do not need to be considered here. In this document, the TLS common model only chooses those TLS1.2 algorithms in TLS Cipher Suites which are marked as recommended: TLS_DHE_RSA_WITH_AES_128_GCM_SHA256,
TLS_DHE_RSA_WITH_AES_256_GCM_SHA384,
TLS_DHE_PSK_WITH_AES_128_GCM_SHA256,
TLS_DHE_PSK_WITH_AES_256_GCM_SHA384, and so on. All chosen algorithms are enumerated in Table 1-1 below;

- TLS 1.3 defines its supported algorithms differently. Firstly, it defines three categories of registries for cryptographic algorithms: TLS Cipher Suites, TLS SignatureScheme, TLS Supported Groups. Secondly, all three of these categories are useful, since they represent different parts of all the supported algorithms respectively. Thus, all of these registries categories are considered here. In this draft, the TLS common model chooses only those TLS1.3 algorithms specified in B.4, 4.2.3, 4.2.7 of [RFC8446].

Thus, in order to support both TLS1.2 and TLS1.3, the cipher-suites part of the hello-params-grouping should include three parameters for configuring its permitted TLS algorithms, which are: TLS Cipher Suites, TLS SignatureScheme, TLS Supported Groups. Note that TLS1.2 only uses TLS Cipher Suites.

[I-D.ietf-netconf-crypto-types] defines six categories of cryptographic algorithms (hash-algorithm, symmetric-key-encryption-algorithm, mac-algorithm, asymmetric-key-encryption-algorithm, signature-algorithm, key-negotiation-algorithm) and lists several widely accepted algorithms for each of them. The TLS client and server models use one or more of these algorithms. The following tables are provided, in part to define the subset of algorithms defined in the crypto-types model used by TLS, and in part to ensure compatibility of configured TLS cryptographic parameters for configuring its permitted TLS algorithms:
<table>
<thead>
<tr>
<th>cipher-suites in hello-params-grouping</th>
<th>HASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>sha-384</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>sha-384</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384</td>
<td>sha-384</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>sha-384</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_CCM</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_CCM</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_CCM</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_CCM</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>sha-384</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_256_CCM_SHA384</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256</td>
<td>sha-256</td>
</tr>
</tbody>
</table>

Table 1-1 TLS 1.2 Compatibility Matrix Part 1: cipher-suites mapping to hash-algorithm
<table>
<thead>
<tr>
<th>cipher-suites in hello-params-grouping</th>
<th>symmetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>enc-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>enc-aes-256-gcm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>enc-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>enc-aes-256-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256</td>
<td>enc-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384</td>
<td>enc-aes-256-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>enc-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>enc-aes-256-gcm</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_CCM</td>
<td>enc-aes-128-ccm</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_CCM</td>
<td>enc-aes-256-ccm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_CCM</td>
<td>enc-aes-128-ccm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_CCM</td>
<td>enc-aes-256-ccm</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>enc-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>enc-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>enc-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>enc-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>enc-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>enc-aes-256-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256</td>
<td>enc-aes-128-ccm</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_256_CCM_SHA384</td>
<td>enc-aes-256-ccm</td>
</tr>
</tbody>
</table>

Table 1-2 TLS 1.2 Compatibility Matrix Part 2: cipher-suites mapping to symmetric-key-encryption-algorithm
<table>
<thead>
<tr>
<th>cipher-suites in hello-params-grouping</th>
<th>MAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_CCM</td>
<td>mac-aes-128-ccm</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_CCM</td>
<td>mac-aes-128-ccm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_CCM</td>
<td>mac-aes-128-ccm</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_CCM</td>
<td>mac-aes-128-ccm</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>mac-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>mac-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>mac-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>mac-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256</td>
<td>mac-aes-128-ccm</td>
</tr>
</tbody>
</table>

Table 1-3 TLS 1.2 Compatibility Matrix Part 3: cipher-suites mapping to MAC-algorithm
<table>
<thead>
<tr>
<th>cipher-suites in hello-params-grouping</th>
<th>signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>rsa-pkcs1-sha384</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256</td>
<td>ecdsa-secp256r1-sha256</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384</td>
<td>ecdsa-secp384r1-sha384</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_CCM</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_CCM</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_CCM</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_CCM</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>ecdsa-secp256r1-sha256</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>N/A</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 1-4 TLS 1.2 Compatibility Matrix Part 4: cipher-suites mapping to signature-algorithm
<table>
<thead>
<tr>
<th>cipher-suites in hello-params-grouping</th>
<th>key-negotiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>psk-dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>psk-dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256</td>
<td>ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384</td>
<td>ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</td>
<td>ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384</td>
<td>ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_128_CCM</td>
<td>dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_AES_256_CCM</td>
<td>dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_128_CCM</td>
<td>psk-dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_AES_256_CCM</td>
<td>psk-dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_ECDSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_DHE_RSA_WITH_CHACHA20_POLY1305_SHA256</td>
<td>dhe-ffdhe2048, ...</td>
</tr>
<tr>
<td>TLS_DHE_PSK_WITH_CHACHA20_POLY1305_SHA256</td>
<td>psk-ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_GCM_SHA256</td>
<td>psk-ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_256_GCM_SHA384</td>
<td>psk-ecdhe-secp256r1, ...</td>
</tr>
<tr>
<td>TLS_ECDHE_PSK_WITH_AES_128_CCM_SHA256</td>
<td>psk-ecdhe-secp256r1, ...</td>
</tr>
</tbody>
</table>

Table 1-5 TLS 1.2 Compatibility Matrix Part 5: cipher-suites mapping to key-negotiation-algorithm

<table>
<thead>
<tr>
<th>cipher-suites in hello-params-grouping</th>
<th>HASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_AES_128_GCM_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_AES_256_GCM_SHA384</td>
<td>sha-384</td>
</tr>
<tr>
<td>TLS_CHACHA20_POLY1305_SHA256</td>
<td>sha-256</td>
</tr>
<tr>
<td>TLS_AES_128_CCM_SHA256</td>
<td>sha-256</td>
</tr>
</tbody>
</table>

Table 2-1 TLS 1.3 Compatibility Matrix Part 1: cipher-suites mapping to hash-algorithm
<table>
<thead>
<tr>
<th>cipher-suites in hello</th>
<th>symmetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_AES_128_GCM_SHA256</td>
<td>enc-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_AES_256_GCM_SHA384</td>
<td>enc-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_CHACHA20_POLY1305_SHA256</td>
<td>enc-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_AES_128_CCM_SHA256</td>
<td>enc-aes-128-ccm</td>
</tr>
</tbody>
</table>

Table 2-2 TLS 1.3 Compatibility Matrix Part 2: cipher-suites mapping to symmetric-key-encryption-algorithm

<table>
<thead>
<tr>
<th>cipher-suites in hello</th>
<th>symmetric</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLS_AES_128_GCM_SHA256</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_AES_256_GCM_SHA384</td>
<td>mac-aes-128-gcm</td>
</tr>
<tr>
<td>TLS_CHACHA20_POLY1305_SHA256</td>
<td>mac-chacha20-poly1305</td>
</tr>
<tr>
<td>TLS_AES_128_CCM_SHA256</td>
<td>mac-aes-128-ccm</td>
</tr>
</tbody>
</table>

Table 2-3 TLS 1.3 Compatibility Matrix Part 3: cipher-suites mapping to MAC-algorithm

<table>
<thead>
<tr>
<th>signatureScheme in hello</th>
<th>signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>rsa-pkcs1-sha256</td>
<td>rsa-pkcs1-sha256</td>
</tr>
<tr>
<td>rsa-pkcs1-sha384</td>
<td>rsa-pkcs1-sha384</td>
</tr>
<tr>
<td>rsa-pkcs1-sha512</td>
<td>rsa-pkcs1-sha512</td>
</tr>
<tr>
<td>rsa-pss-rsae-sha256</td>
<td>rsa-pss-rsae-sha256</td>
</tr>
<tr>
<td>rsa-pss-rsae-sha384</td>
<td>rsa-pss-rsae-sha384</td>
</tr>
<tr>
<td>rsa-pss-rsae-sha512</td>
<td>rsa-pss-rsae-sha512</td>
</tr>
<tr>
<td>rsa-pss-pss-sha256</td>
<td>rsa-pss-pss-sha256</td>
</tr>
<tr>
<td>rsa-pss-pss-sha384</td>
<td>rsa-pss-pss-sha384</td>
</tr>
<tr>
<td>rsa-pss-pss-sha512</td>
<td>rsa-pss-pss-sha512</td>
</tr>
<tr>
<td>ecdsa-secp256r1-sha256</td>
<td>ecdsa-secp256r1-sha256</td>
</tr>
<tr>
<td>ecdsa-secp384r1-sha384</td>
<td>ecdsa-secp384r1-sha384</td>
</tr>
<tr>
<td>ecdsa-secp521r1-sha512</td>
<td>ecdsa-secp521r1-sha512</td>
</tr>
<tr>
<td>ed25519</td>
<td>ed25519</td>
</tr>
<tr>
<td>ed448</td>
<td>ed448</td>
</tr>
</tbody>
</table>

Table 2-4 TLS 1.3 Compatibility Matrix Part 4: SignatureScheme mapping to signature-algorithm
<table>
<thead>
<tr>
<th>supported Groups in hello</th>
<th>key-negotiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>dhe-ffdhe2048</td>
<td>dhe-ffdhe2048</td>
</tr>
<tr>
<td>dhe-ffdhe3072</td>
<td>dhe-ffdhe3072</td>
</tr>
<tr>
<td>dhe-ffdhe4096</td>
<td>dhe-ffdhe4096</td>
</tr>
<tr>
<td>dhe-ffdhe6144</td>
<td>dhe-ffdhe6144</td>
</tr>
<tr>
<td>dhe-ffdhe8192</td>
<td>dhe-ffdhe8192</td>
</tr>
<tr>
<td>psk-dhe-ffdhe2048</td>
<td>psk-dhe-ffdhe2048</td>
</tr>
<tr>
<td>psk-dhe-ffdhe3072</td>
<td>psk-dhe-ffdhe3072</td>
</tr>
<tr>
<td>psk-dhe-ffdhe4096</td>
<td>psk-dhe-ffdhe4096</td>
</tr>
<tr>
<td>psk-dhe-ffdhe6144</td>
<td>psk-dhe-ffdhe6144</td>
</tr>
<tr>
<td>psk-dhe-ffdhe8192</td>
<td>psk-dhe-ffdhe8192</td>
</tr>
<tr>
<td>ecdhe-secp256r1</td>
<td>ecdhe-secp256r1</td>
</tr>
<tr>
<td>ecdhe-secp384r1</td>
<td>ecdhe-secp384r1</td>
</tr>
<tr>
<td>ecdhe-secp521r1</td>
<td>ecdhe-secp521r1</td>
</tr>
<tr>
<td>ecdhe-x25519</td>
<td>ecdhe-x25519</td>
</tr>
<tr>
<td>ecdhe-x448</td>
<td>ecdhe-x448</td>
</tr>
<tr>
<td>psk-ecdhe-secp256r1</td>
<td>psk-ecdhe-secp256r1</td>
</tr>
<tr>
<td>psk-ecdhe-secp384r1</td>
<td>psk-ecdhe-secp384r1</td>
</tr>
<tr>
<td>psk-ecdhe-secp521r1</td>
<td>psk-ecdhe-secp521r1</td>
</tr>
<tr>
<td>psk-ecdhe-x25519</td>
<td>psk-ecdhe-x25519</td>
</tr>
<tr>
<td>psk-ecdhe-x448</td>
<td>psk-ecdhe-x448</td>
</tr>
</tbody>
</table>

Table 2-5 TLS 1.3 Compatibility Matrix Part 5: Supported Groups mapping to key-negotiation-algorithm

Note that in Table 1-5:

- dhe-ffdhe2048, ... is the abbreviation of dhe-ffdhe2048, dhe-ffdhe3072, dhe-ffdhe4096, dhe-ffdhe6144, dhe-ffdhe8192;

- psk-dhe-ffdhe2048, ... is the abbreviation of psk-dhe-ffdhe2048, psk-dhe-ffdhe3072, psk-dhe-ffdhe4096, psk-dhe-ffdhe6144, psk-dhe-ffdhe8192;

- ecdhe-secp256r1, ... is the abbreviation of ecdhe-secp256r1, ecdhe-secp384r1, ecdhe-secp521r1, ecdhe-x25519, ecdhe-x448;

- psk-ecdhe-secp256r1, ... is the abbreviation of psk-ecdhe-secp256r1, psk-ecdhe-secp384r1, psk-ecdhe-secp521r1, psk-ecdhe-x25519, psk-ecdhe-x448.

Features are defined for algorithms that are OPTIONAL or are not widely supported by popular implementations. Note that the list of algorithms is not exhaustive.
5.1. Tree Diagram

The following tree diagram [RFC8340] provides an overview of the data model for the "ietf-tls-common" module.

```
module: ietf-tls-common

grouping hello-params-grouping
  +-- tls-versions
      |  +-- tls-version*     identityref
      +-- cipher-suites
          +-- cipher-suite*     identityref
```

5.2. Example Usage

This section shows how it would appear if the transport-params-grouping were populated with some data.

```
<hello-params
  xmlns="urn:ietf:params:xml:ns:yang:ietf-tls-common"
  <tls-versions>
    <tls-version>tlscmn:tls-1.1</tls-version>
    <tls-version>tlscmn:tls-1.2</tls-version>
  </tls-versions>
  <cipher-suites>
    <cipher-suite>tlscmn:rsa-with-aes-128-cbc-sha</cipher-suite>
    <cipher-suite>tlscmn:rsa-with-3des-ede-cbc-sha</cipher-suite>
  </cipher-suites>
</hello-params>
```

5.3. YANG Module

This YANG module has a normative references to [RFC4346], [RFC5246], [RFC5288], [RFC5289], and [RFC8422].

This YANG module has a informative references to [RFC2246], [RFC4346], [RFC5246], and [RFC8446].

```
<CODE BEGINS> file "ietf-tls-common@2019-11-02.yang"

module ietf-tls-common {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-tls-common";
  prefix tlscmn;

  organization
```

```
This module defines a common features, identities, and groupings for Transport Layer Security (TLS).

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

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 2019-11-02 {
  description
    "Initial version";
  reference
    "RFC XXXX: YANG Groupings for TLS Clients and TLS Servers";
}

// Features

feature tls-1_0 {
  description
    "TLS Protocol Version 1.0 is supported.";
  reference
    "RFC 2246: The TLS Protocol Version 1.0";
}
feature tls-1_1 {
  description
    "TLS Protocol Version 1.1 is supported.";
  reference
}

feature tls-1_2 {
  description
    "TLS Protocol Version 1.2 is supported.";
  reference
}

feature tls-1_3 {
  description
    "TLS Protocol Version 1.2 is supported.";
  reference
}

feature tls-ecc {
  description
    "Elliptic Curve Cryptography (ECC) is supported for TLS.";
  reference
    "RFC 8422: Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS)";
}

feature tls-dhe {
  description
    "Ephemeral Diffie-Hellman key exchange is supported for TLS.";
  reference
}

feature tls-3des {
  description
    "The Triple-DES block cipher is supported for TLS.";
  reference
}
feature tls-gcm {
    description
        "The Galois/Counter Mode authenticated encryption mode is
        supported for TLS.";
    reference
        "RFC 5288: AES Galois Counter Mode (GCM) Cipher Suites for
        TLS";
}

feature tls-sha2 {
    description
        "The SHA2 family of cryptographic hash functions is supported
        for TLS.";
    reference
        "FIPS PUB 180-4: Secure Hash Standard (SHS)";
}

// Identities

identity tls-version-base {
    description
        "Base identity used to identify TLS protocol versions.";
}

identity tls-1.0 {
    if-feature "tls-1_0";
    base tls-version-base;
    description
        "TLS Protocol Version 1.0.";
    reference
        "RFC 2246: The TLS Protocol Version 1.0";
}

identity tls-1.1 {
    if-feature "tls-1_1";
    base tls-version-base;
    description
        "TLS Protocol Version 1.1.";
    reference
        Version 1.1";
}

identity tls-1.2 {
    if-feature "tls-1_2";
    base tls-version-base;
    description
        "TLS Protocol Version 1.2.";
}
reference
}

identity cipher-suite-base {
  description
  "Base identity used to identify TLS cipher suites."
}

identity rsa-with-aes-128-cbc-sha {
  base cipher-suite-base;
  description
  "Cipher suite TLS_RSA_WITH_AES_128_CBC_SHA."
  reference
}

identity rsa-with-aes-256-cbc-sha {
  base cipher-suite-base;
  description
  "Cipher suite TLS_RSA_WITH_AES_256_CBC_SHA."
  reference
}

identity rsa-with-aes-128-cbc-sha256 {
  if-feature "tls-sha2";
  base cipher-suite-base;
  description
  "Cipher suite TLS_RSA_WITH_AES_128_CBC_SHA256."
  reference
}

identity rsa-with-aes-256-cbc-sha256 {
  if-feature "tls-sha2";
  base cipher-suite-base;
  description
  "Cipher suite TLS_RSA_WITH_AES_256_CBC_SHA256."
  reference
}
identity dhe-rsa-with-aes-128-cbc-sha {
  if-feature "tls-dhe";
  base cipher-suite-base;
  description
    "Cipher suite TLS_DHE_RSA_WITH_AES_128_CBC_SHA.";
  reference
}

identity dhe-rsa-with-aes-128-cbc-sha256 {
  if-feature "tls-dhe and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_DHE_RSA_WITH_AES_128_CBC_SHA256.";
  reference
}

identity ecdhe-ecdsa-with-aes-128-cbc-sha256 {
  if-feature "tls-ecc and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256.";
  reference
    "RFC 5289: TLS Elliptic Curve Cipher Suites with SHA-256/384 and AES Galois Counter Mode (GCM)";
}
identity ecdhe-ecdsa-with-aes-256-cbc-sha384 {
  if-feature "tls-ecc and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384.";
  reference
    "RFC 5289: TLS Elliptic Curve Cipher Suites with
     SHA-256/384 and AES Galois Counter Mode (GCM)";
}

identity ecdhe-rsa-with-aes-128-cbc-sha256 {
  if-feature "tls-ecc and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256.";
  reference
    "RFC 5289: TLS Elliptic Curve Cipher Suites with
     SHA-256/384 and AES Galois Counter Mode (GCM)";
}

identity ecdhe-rsa-with-aes-256-cbc-sha384 {
  if-feature "tls-ecc and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384.";
  reference
    "RFC 5289: TLS Elliptic Curve Cipher Suites with
     SHA-256/384 and AES Galois Counter Mode (GCM)";
}

identity ecdhe-ecdsa-with-aes-128-gcm-sha256 {
  if-feature "tls-ecc and tls-gcm and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256.";
  reference
    "RFC 5289: TLS Elliptic Curve Cipher Suites with
     SHA-256/384 and AES Galois Counter Mode (GCM)";
}

identity ecdhe-ecdsa-with-aes-256-gcm-sha384 {
  if-feature "tls-ecc and tls-gcm and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384.";
  reference

"RFC 5289": TLS Elliptic Curve Cipher Suites with SHA-256/384 and AES Galois Counter Mode (GCM);

identity ecdhe-rsa-with-aes-128-gcm-sha256 {
  if-feature "tls-ecc and tls-gcm and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256.";
  reference
    "RFC 5289": TLS Elliptic Curve Cipher Suites with SHA-256/384 and AES Galois Counter Mode (GCM);
}

identity ecdhe-rsa-with-aes-256-gcm-sha384 {
  if-feature "tls-ecc and tls-gcm and tls-sha2";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384.";
  reference
    "RFC 5289": TLS Elliptic Curve Cipher Suites with SHA-256/384 and AES Galois Counter Mode (GCM);
}

identity rsa-with-3des-ede-cbc-sha {
  if-feature "tls-3des";
  base cipher-suite-base;
  description
    "Cipher suite TLS_RSA_WITH_3DES_EDE_CBC_SHA.";
  reference
    "RFC 5246": The Transport Layer Security (TLS) Protocol Version 1.2;
}

identity ecdhe-rsa-with-3des-ede-cbc-sha {
  if-feature "tls-ecc and tls-3des";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA.";
  reference
    "RFC 8422": Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS);
}

identity ecdhe-rsa-with-aes-128-cbc-sha {
  if-feature "tls-ecc";
  base cipher-suite-base;
  description
"Cipher suite TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA.";
reference
"RFC 8422: Elliptic Curve Cryptography (ECC) Cipher Suites
for Transport Layer Security (TLS)";
}

identity ecdhe-rsa-with-aes-256-cbc-sha {
  if-feature "tls-ecc";
  base cipher-suite-base;
  description
    "Cipher suite TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA.";
  reference
    "RFC 8422: Elliptic Curve Cryptography (ECC) Cipher Suites
    for Transport Layer Security (TLS)";
}

// Groupings

grouping hello-params-grouping {
  description
    "A reusable grouping for TLS hello message parameters.";
  reference
    Version 1.2";
  container tls-versions {
    description
      "Parameters regarding TLS versions.";
    leaf-list tls-version {
      type identityref {
        base tls-version-base;
      }
      description
        "Acceptable TLS protocol versions.

        If this leaf-list is not configured (has zero elements)
        the acceptable TLS protocol versions are implementation-
        defined.";
    }
  }
  container cipher-suites {
    description
      "Parameters regarding cipher suites.";
    leaf-list cipher-suite {
      type identityref {
        base cipher-suite-base;
      }
      ordered-by user;
      description
        "Cipher suite TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA.";
    }
  }
}
Acceptable cipher suites in order of descending preference. The configured host key algorithms should be compatible with the algorithm used by the configured private key. Please see Section 5 of RFC XXXX for valid combinations.

If this leaf-list is not configured (has zero elements) the acceptable cipher suites are implementation-defined.

Reference

"RFC XXXX: YANG Groupings for TLS Clients and TLS Servers";

6. Security Considerations

The YANG modules defined in this document 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 NETCONF 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 modules in this document only define groupings, these considerations are primarily for the designers of other modules that use these groupings.

There are a number of data nodes defined in the YANG modules 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:

*: The entire subtree defined by the grouping statement in both the "ietf-ssh-client" and "ietf-ssh-server" modules is sensitive to write operations. For instance, the addition or removal of references to keys, certificates, trusted anchors, etc., or even the modification of transport or keepalive parameters can dramatically alter the implemented security
policy. For this reason, this node is protected the NACM extension "default-deny-write".

Some of the readable data nodes in the YANG modules 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:

/tls-client-parameters/client-identity/: This subtree in the "ietf-tls-client" module contains nodes that are additionally sensitive to read operations such that, in normal use cases, they should never be returned to a client. Some of these nodes (i.e., public-key/local-definition/private-key and certificate/local-definition/private-key) are already protected by the NACM extension "default-deny-all" set in the "grouping" statements defined in [I-D.ietf-netconf-crypto-types].

/tls-server-parameters/server-identity/: This subtree in the "ietf-tls-server" module contains nodes that are additionally sensitive to read operations such that, in normal use cases, they should never be returned to a client. All of these nodes (i.e., host-key/public-key/local-definition/private-key and host-key/certificate/local-definition/private-key) are already protected by the NACM extension "default-deny-all" set in the "grouping" statements defined in [I-D.ietf-netconf-crypto-types].

Some of the 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:

*: The groupings defined in this document include "action" statements that come from groupings defined in [I-D.ietf-netconf-crypto-types]. Please consult that document for the security considerations of the "action" statements defined by the "grouping" statements defined in this document.

7. IANA Considerations

7.1. 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:
7.2. 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-tls-client
  - prefix: tlsc
  - reference: RFC XXXX

- **name:** ietf-tls-server
  - prefix: tlss
  - reference: RFC XXXX

- **name:** ietf-tls-common
  - prefix: tlscmn
  - reference: RFC XXXX

8. References

8.1. Normative References

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

- [I-D.ietf-netconf-keystore]


8.2. Informative References


Appendix A. Change Log

A.1. 00 to 01

- Noted that ‘0.0.0.0’ and ‘::’ might have special meanings.
- Renamed "keychain" to "keystore".

A.2. 01 to 02

- Removed the groupings containing transport-level configuration. Now modules contain only the transport-independent groupings.
- Filled in previously incomplete ‘ietf-tls-client’ module.
- Added cipher suites for various algorithms into new ‘ietf-tls-common’ module.

A.3. 02 to 03

- Added a ‘must’ statement to container ‘server-auth’ asserting that at least one of the various auth mechanisms must be specified.
- Fixed description statement for leaf ‘trusted-ca-certs’.

A.4. 03 to 04

- Updated title to "YANG Groupings for TLS Clients and TLS Servers"
- Updated leafref paths to point to new keystore path
- Changed the YANG prefix for ietf-tls-common from ‘tlscom’ to ‘tlscmn’.
- Added TLS protocol versions 1.0 and 1.1.
- Made author lists consistent
- Now tree diagrams reference ietf-netmod-yang-tree-diagrams
- Updated YANG to use typedefs around leafrefs to common keystore paths
- Now inlines key and certificates (no longer a leafref to keystore)
A.5. 04 to 05
  o Merged changes from co-author.

A.6. 05 to 06
  o Updated to use trust anchors from trust-anchors draft (was keystore draft)
  o Now Uses new keystore grouping enabling asymmetric key to be either locally defined or a reference to the keystore.

A.7. 06 to 07
  o factored the tls-[client|server]-groupings into more reusable groupings.
  o added if-feature statements for the new "x509-certificates" feature defined in draft-ietf-netconf-trust-anchors.

A.8. 07 to 08
  o Added a number of compatibility matrices to Section 5 (thanks Frank!)
  o Clarified that any configured "cipher-suite" values need to be compatible with the configured private key.

A.9. 08 to 09
  o Updated examples to reflect update to groupings defined in the keystore draft.
  o Add TLS keepalives features and groupings.
  o Prefixed top-level TLS grouping nodes with ’tls-’ and support mashups.
  o Updated copyright date, boilerplate template, affiliation, and folding algorithm.

A.10. 09 to 10
  o Reformatted the YANG modules.
A.11. 10 to 11

- Collapsed all the inner groupings into the top-level grouping.
- Added a top-level "demux container" inside the top-level grouping.
- Added NACM statements and updated the Security Considerations section.
- Added "presence" statements on the "keepalive" containers, as was needed to address a validation error that appeared after adding the "must" statements into the NETCONF/RESTCONF client/server modules.
- Updated the boilerplate text in module-level "description" statement to match copyeditor convention.

A.12. 11 to 12

- In server model, made ‘client-authentication’ a ‘presence’ node indicating that the server supports client authentication.
- In the server model, added a ‘required-or-optional’ choice to ‘client-authentication’ to better support protocols such as RESTCONF.
- In the server model, added a ‘local-or-external’ choice to ‘client-authentication’ to better support consuming data models that prefer to keep client auth with client definitions than in a model principally concerned with the "transport".
- In both models, removed the "demux containers", floating the nacm:default-deny-write to each descendent node, and adding a note to model designers regarding the potential need to add their own demux containers.
- Fixed a couple references (section 2 --> section 3)

A.13. 12 to 13

- Updated to reflect changes in trust-anchors drafts (e.g., s/trust-anchors/truststore/g + s/pinned.//)

A.14. 12 to 13

- Removed ‘container’ under ‘client-identity’ to match server model.
- Updated examples to reflect change grouping in keystore module.
A.15. 13 to 14

- Removed the "certificate" container from "client-identity" in the ietf-tls-client module.
- Updated examples to reflect ietf-crypto-types change (e.g., identities --> enumerations)

A.16. 14 to 15

- Updated "server-authentication" and "client-authentication" nodes from being a leaf of type "ts:certificates-ref" to a container that uses "ts:local-or-truststore-certs-grouping".

A.17. 15 to 16

- Removed unnecessary if-feature statements in the -client and -server modules.
- Cleaned up some description statements in the -client and -server modules.
- Fixed a canonical ordering issue in ietf-tls-common detected by new pyang.

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Authors’ Addresses

Kent Watsen
Watsen Networks
EMail: kent+ietf@watsen.net

Gary Wu
Cisco Systems
EMail: garywu@cisco.com