Yang data model for Terminal Access Controller Access Control System Plus
draft-zheng-opsawg-tacacs-yang-01

Abstract

This document defines two YANG modules that augment the System data model defined in the [RFC 7317] with TACACS+ client model and additional AAA model. The data model of Terminal Access Controller Access Control System Plus (TACACS+) client allows the configuration of TACACS+ servers for centralized Authentication, Authorization and Accounting. While the current system model only supports authentication configuration, the additional AAA model allows system authorization and accounting configuration.

The YANG modules in this document conforms to the Network Management Datastore Architecture (NMDA) defined in [RFC8342].

Status of This Memo

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1. Introduction

This document defines two YANG modules that augment the System data model defined in the [RFC 7317] with TACACS+ client model and additional AAA model. The data model of Terminal Access Controller Access Control System Plus (TACACS+) client allows the configuration of TACACS+ servers for centralized Authentication, Authorization and Accounting. While the current system model only supports authentication configuration, the additional AAA model allows system authorization and accounting configuration.

TACACS+ provides Device Administration for routers, network access servers and other networked computing devices via one or more centralized servers which is defined in the TACACS+ Protocol. [I-D.ietf-opsawg-tacacs]

A YANG Data Model for System Management [RFC 7317] defines two YANG features to support local or RADIUS authentication:

- User Authentication Model: Define a list of usernames and passwords and control the order in which local or RADIUS authentication is used.
RADIUS Client Model: Defines a list of RADIUS server that a device used.

Since TACACS+ is also used for device management and the feature is not contained in the system model, this document defines a YANG data model that allows users to configure TACACS+ client functions on a device.

Additionally, to support full AAA feature, the "ietf-aaa" YANG module defined in this document provides user authorization model and user accounting model. The additional AAA model is intended to be used together with the authentication feature of the System model, to authorize what services that a user is allowed to use, and to maintain a record of the actions performed when a user logging on.

The YANG models can be used with network management protocols such as NETCONF [RFC6241] to install, manipulate, and delete the configuration of network devices.

The YANG data model in this document conforms to the Network Management Datastore Architecture (NMDA) defined in [RFC8342].

2. Conventions used in this document

The keywords "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 BCP14, [RFC2119], [RFC8174] when, and only when, they appear in all capitals, as shown here.

The following terms are defined in [RFC6241] and are used in this specification:

- client
- configuration data
- server
- state data

The following terms are defined in [RFC7950] and are used in this specification:

- augment
- data model
1.  Data Node

The terminology for describing YANG data models is found in [RFC7950].

2.1.  Tree Diagrams

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

3.  TACACSPLUS Client Model

This model is used to configure TACACS+ client on the device to support deployment scenarios with centralized authentication, authorization, and accounting servers. Authentication is used to validate a user’s name and password, authorization allows the user to access and execute commands at various command levels assigned to the user and accounting keeps track of the activity of a user who has accessed the device.

The ietf-tacacs module is intended to augment the "/sys:system" path defined in the ietf-system module with "tacacs" grouping. Therefore, a device can use local, Remote Authentication Dial In User Service (RADIUS), or Terminal Access Controller Access Control System Plus (TACACS+) to validate users who attempt to access the router by several mechanisms, e.g. a command line interface or a web-based user interface.

The "server" list is directly under the "tacacs" container, which is to hold a list of different TACACS+ server and use server-type to distinguish the three protocols. The list of servers is for redundancy purpose.

The "statistics" container under the "server list" is to record session statistics and usage information during user access which include the amount of data a user has sent and/or received during a session.

The data model for tacacs has the following structure:
module: ietf-aaa-tacacs
augment /sys:system:
  +--rw tacacs {tacacs}?
    +--rw server* [name]
      |  +--rw name      string
      |  +--rw server-type? enumeration
      |  +--rw address   inet:host
      |  +--rw port?     inet:port-number
      |  +--rw shared-secret string
      |  +--rw source-ip? inet:ip-address
      |  +--rw single-connection? boolean
    +--ro statistics
      |  +--ro connection-opens? yang:counter64
      |  +--ro connection-closes?  yang:counter64
      |  +--ro connection-aborts?  yang:counter64
      |  +--ro connection-failures?  yang:counter64
      |  +--ro connection-timeouts?  yang:counter64
      |  +--ro messages-sent?  yang:counter64
      |  +--ro messages-received?  yang:counter64
      |  +--ro errors-received?  yang:counter64
    +--rw options
    +--rw timeout? uint16

4. AAA Model Augmentation

This document augments the system model with authorization model and accounting model to support full AAA feature.

For the authentication model, if the NETCONF server advertises the "tacacs" feature, the device also supports user authentication using TACACSPPLUS. For NETCONF transport protocols that support password authentication, the leaf-list "user-authentication-order" is used to control if TACACSPPLUS password authentication should be used.

For the authorization model and accounting model, the extended AAA data model has the following structure:
module: ietf-system-aaa
    augment /sys:system:
        +-rw authorization {authorization}?
        |    +-rw user-authorization-order* identityref
        |    +-rw events
        |         +-rw event* [event-type]
        |             +-rw event-type identityref
        +-rw accounting {accounting}?
        |    +-rw user-accounting-order* identityref
        |    +-rw events
        |         +-rw event* [event-type]
        |             +-rw event-type identityref
        |             +-rw record? enumeration

4.1. User Authorization Model

Following authentication, a user must gain authorization for doing certain tasks. For instance, the user may try to issue commands. The authorization process determines whether the user has the authority to issue such commands.

This document defines two optional authorization YANG features: "local-users" and "tacacs", which the server advertises to indicate support for configuring local users on the device and support for using TACACSPLUS for authorization, respectively.

In addition, an authorization parameter is defined to indicate a specific authorization event, and an event can be added by defining other event identifiers. Currently, "aaa_authorization_event_command" is used to determine whether the user is allowed to run commands.

4.2. User Accounting Model

Accounting is used to record the authorization information and accounting specific information such as start and stop times and resource usage information.

This document defines two optional accounting YANG features: "local-users" and "tacacs", which the server advertises to indicate support for configuring local users on the device and support for using TACACSPLUS for accounting, respectively.

Two accounting parameters are defined to indicate specific accounting event and also the record type.

- "event type": "aaa_accounting_event_command" is defined to record commands issued by the user.
Start records indicate that an accounting service is about to begin. Stop records indicate that a service has just terminated.

5. TACACS+ Module

<CODE BEGINS> file "ietf-aaa-tacacs@2019-03-06.yang"

module ietf-aaa-tacacs {
  yang-version 1.1;
  prefix aaa-tcs;

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

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

  import ietf-network-instance {
    prefix ni;
    reference "draft-ietf-rtgwg-ni-model-12: YANG Model for Network Instances";
  }

  import ietf-system {
    prefix sys;
    reference "RFC 7317: A YANG Data Model for System Management";
  }

  import ietf-netconf-acm {
    prefix nacm;
  }

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

  contact
    "WG Web: <http://tools.ietf.org/wg/opsawg/>
    WG List: <mailto:opsawg@ietf.org>
    Editor: Guangying Zheng
    <mailto:zhengguangying@huawei.com>";

  description
    "This module provides configuration of TACACS+ client.
    
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This version of this YANG module is part of RFC XXXX; see the RFC itself for full legal notices.

revision 2019-03-06 {
  description
    "Initial revision.";
  reference "foo";
}

feature tacacs {
  description
    "Indicates that the device can be configured as a TACACSPPLUS client.";
  reference "draft-ietf-opsawg-tacacs-11: The TACACSPPLUS Protocol";
}

grouping statistics {
  description
    "Grouping for statistics attributes";
  container statistics {
    config false;
    description
      "A collection of server-related statistics objects";
    leaf connection-opens {
      type yang:counter64;
      description
        "Number of new connection requests sent to the server, e.g. socket open";
    }
    leaf connection-closes {
      type yang:counter64;
      description
        "Number of connection close requests sent to the server, e.g. socket close";
    }
    leaf connection-aborts {
      type yang:counter64;
      description
        "Number of aborted connections to the server. These do
not include connections that are close gracefully.

} leaf connection-failures {
type yang:counter64;
description "Number of connection failures to the server";
}
leaf connection-timeouts {
type yang:counter64;
description "Number of connection timeouts to the server";
}
leaf messages-sent {
type yang:counter64;
description "Number of messages sent to the server";
}
leaf messages-received {
type yang:counter64;
description "Number of messages received by the server";
}
leaf errors-received {
type yang:counter64;
description "Number of error messages received from the server";
}
}
}
grouping tacacs {
description "Grouping for tacacs attributes";
container tacacs {
if-feature "tacacs"

description "Container for TACACS+ configurations and operations."

list server {
key "name";
ordered-by user;
description "List of TACACS+ servers used by the device

When the TACACS client is invoked by a calling application, it sends the query to the first server in this list. If no response has been received within 'timeout' seconds, the client continues with the next server in the list. If no response is received from any server, the client will eventually give up and fail gracefully.

server, the client continues with the first server again. When the client has traversed the list ‘attempts’ times without receiving any response, it gives up and returns an error to the calling application.

leaf name {
  type string;
  description
  "An arbitrary name for the TACACS+ server."
}
leaf server-type {
  type enumeration {
    enum authentication {
      description
      "The server is an authentication server."
    }
    enum authorization {
      description
      "The server is an authorization server."
    }
    enum accounting {
      description
      "The server is an accounting server."
    }
  }
  description
  "Server type: authentication/authorization/accounting."
}
leaf address {
  type inet:host;
  mandatory true;
  description
  "The address of the TACACS+ server."
}
leaf port {
  type inet:port-number;
  default "49";
  description
  "The port number of TACACSPLUS Server port."
}
leaf shared-secret {
  type string;
  mandatory true;
  nacm:default-deny-all;
  description
  "The shared secret, which is known to both the TACACS client and server. TACACS+ server administrators SHOULD configure secret keys of minimum 16 characters length.";
reference "tacacs protocol:";
}
leaf source-ip {
    type inet:ip-address;
    description
        "Source IP address for a TACACS+ server.";
}
leaf single-connection {
    type boolean;
    default "false";
    description
        "Whether the single connection mode is enabled for the
        server. By default, the single connection mode is
        disabled.";
}
leaf network-instance {
    type leafref {
        path "ni:network-instances/ni:network-instance/ni:name";
    }
    description
        "Configure the vpn-instance name.";
}
uses statistics;
}
container options {
    description
        "TACACS+ client options.";
    leaf timeout {
        type uint16 {
            range "1..300";
        }
        units "seconds";
        default "5";
        description
            "The number of seconds the device will wait for a
            response from each TACACS+ server before trying with a
            different server.";
    }
}

augment "/sys:system" {
    description
        "Augment the system model with authorization and accounting
        attributes
        Augment the system model with the tacacs model";
    uses tacacs;
6. AAA Module

<CODE BEGINS> file "ietf-system-aaa@2019-03-06.yang"

module ietf-system-aaa {
    yang-version 1.1;
    namespace "urn:ietf:params:xml:ns:yang:ietf-system-aaa";
    prefix sys-aaa;

    import ietf-system {
        prefix sys;
        reference "RFC 7317: A YANG Data Model for System Management";
    }
    import ietf-netconf-acm {
        prefix nacm;
    }

    organization
        "IETF Opsawg (Operations and Management Area Working Group)";
    contact
        "WG Web:  <http://tools.ietf.org/wg/opsawg/>
        WG List: <mailto:opsawg@ietf.org>
        Editor:  Guangying Zheng
        <mailto:zhengguangying@huawei.com>"
    description
        "This module provides configuration of system AAA.

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        without modification, is permitted pursuant to, and subject
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        Relating to IETF Documents
        (http://trustee.ietf.org/license-info).

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

    revision 2019-03-06 {


description
    "Initial revision.";
reference "foo";
}

feature authorization {
    description
    "Indicates that the device supports configuration of
    user authorization.";
}

feature accounting {
    description
    "Indicates that the device supports configuration of
    user accounting.";
}

identity authorization-method {
    description
    "Base identity for user authorization methods.";
}

identity accounting-method {
    description
    "Base identity for user accounting methods.";
}

identity tacacs {
    base sys:authentication-method;
    base authorization-method;
    base accounting-method;
    description
    "Indicates AAA operation using TACACS+.";
    reference "draft-ietf-opsawg-tacacs-11: The TACACS+ Protocol";
}

identity local-users {
    base sys:authentication-method;
    base authorization-method;
    base accounting-method;
    description
    "Indicates accounting of locally
    configured users.";
}

identity aaa_accounting_event_type {
    description
    "Base identity for specifying events types that should be
sent to AAA server for accounting;
}

identity aaa_accounting_event_command {
    base aaa_accounting_event_type;
    description
        "Specifies interactive command events for AAA accounting";
}

identity aaa_authorization_event_type {
    description
        "Base identity for specifying activities that should be
        sent to AAA server for authorization";
}

identity aaa_authorization_event_command {
    base aaa_authorization_event_type;
    description
        "Specifies interactive command events for AAA authorization";
}

augment "/sys:system" {
    description
        "Augment the system model with authorization and accounting
        attributes
        Augment the system model with the tacacs model";
    container authorization {
        nacm:default-deny-write;
        if-feature "authorization";
        description
            "The authorization configuration subtree.";
        leaf-list user-authorization-order {
            type identityref {
                base authorization-method;
            }
            ordered-by user;
            description
                "When the device authorize a user, it tries the authorization
                methods in this leaf-list in order. If authorization with
                one method fails, the next method is used. If no method
                succeeds, the user is denied access.

                If the 'tacacs-authentication' feature is advertised by
                the NETCONF server, the 'tacacs' identity can be added to
                this list.
                If the 'local-users' feature is advertised by the
                NETCONF server, the 'local-users' identity can be
                added to this list.";
        }
    }
}
container events {
  description "The container contains an set of authorization events";
  list event {
    key "event-type";
    description "List of events of AAA authorization";
    leaf event-type {
      type identityref {
        base aaa_authorization_event_type;
      }
      description "The type of event to record at the AAA authorization server";
    }
  }
}

container accounting {
  nacm:default-deny-write;
  if-feature "accounting";
  description "The accounting configuration subtree.";
  leaf-list user-accounting-order {
    type identityref {
      base accounting-method;
    }
    ordered-by user;
    description "When the device audit a user with a password, it tries the accounting methods in this leaf-list in order. The accounting method may be specified as TACACS+ servers, or the local.";
  }
}

container events {
  description "The container contains an set of accounting events";
  list event {
    key "event-type";
    description "List of events of accounting";
    leaf event-type {
      type identityref {
        base aaa_accounting_event_type;
      }
      description "The type of activity to record at the AAA accounting";
    }
  }
}
7. Security Considerations

The YANG module defined in this document is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [RFC6242]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [RFC8446].

The NETCONF access control model [RFC6536] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

There are a number of data nodes defined in this YANG module that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative effect on network operations.
This document describes the use of TACACS+ for purposes of authentication, authorization and accounting, it is vulnerable to all of the threats that are present in TACACS+ applications. For a discussion of such threats, see Section 9 of the TACACS+ Protocol [I-D.ietf-opsawg-tacacs].

8. IANA Considerations

This document registers a URI in the IETF XML registry [RFC3688]. Following the format in [RFC3688], the following registration is requested to be made:

Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.

This document registers a YANG module in the YANG Module Names registry [RFC7950].

Name: ietf-tacacs
Prefix: tcs
Reference: RFC XXXX

9. Normative References

[I-D.ietf-opsawg-tacacs]


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