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YANG Data Model for System Management  
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## Abstract

This document defines a YANG data model for the configuration and identification of the management system of a device.

## Status of this Memo

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YANG System Management

October 2011

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## 1. Introduction

This document defines a YANG [[RFC6020](#)] data model for the configuration and identification of the management system of a device.

Devices that are managed by NETCONF and perhaps other mechanisms have common properties that need to be configured and monitored in a standard way.

The YANG module defined in this document provides the following features:

- o system administrative data configuration
- o system identification monitoring
- o system time-of-day configuration and monitoring
- o user authentication configuration
- o local users configuration

### 1.1. Terminology

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 [BCP 14](#), [[RFC2119](#)].

#### 1.1.1. Terms

The following terms are used within this document:

- o system: This term refers to the embodiment of the entire set of management interfaces that a single NETCONF server is supporting

at a given moment. The set of physical entities managed by a single NETCONF server can be static or it can change dynamically.

## [2.](#) Objectives

### [2.1.](#) System Identification

There are many common properties used to identify devices, operating systems, software versions, etc. that need to be supported in the system data module. These objects are defined as operational data and intended to be specific to the device vendor.

Some user-configurable administrative strings are also provided such as the system location and description.

### [2.2.](#) System Time Management

The management of the date and time used by the system need to be supported. Use of one or more NTP servers to automatically set the system date and time need to be possible. Utilization of the Timezone database [[I-D.lear-iana-timezone-database](#)] also need to be supported.

### [2.3.](#) User Authentication

The authentication mechanism need to support password authentication over RADIUS, to support deployment scenarios with centralized authentication servers. Additionally, local users need to be supported, for scenarios when no centralized authentication server exists, or for situations where the centralized authentication server cannot be reached from the device.

Since the mandatory transport protocol for NETCONF is SSH [[RFC6242](#)] the authentication model need to support SSH's "publickey" and "password" authentication methods [[RFC4252](#)].

The model for authentication configuration should be flexible enough to support authentication methods defined by other standard documents or by vendors.

### [3.](#) System Data Model

#### [3.1.](#) System Identification

The data model for system identification has the following structure:

```
+--rw system
  +--rw contact?      string
  +--rw name?         string
  +--rw location?     string
  +--ro platform
    +--ro os-name?    string
    +--ro os-release? string
    +--ro os-version? string
    +--ro machine?    string
    +--ro nodename?   string
```

#### [3.2.](#) System Time Management

The data model for system time management has the following structure:

```

+--rw system
  +--rw clock
    |   +--ro current-datetime?      yang:date-and-time
    |   +--ro boot-datetime?         yang:date-and-time
    |   +--rw (timezone)?
    |     +--:(timezone-location)
    |       |   +--rw timezone-location?  string
    |       +--:(timezone-name)
    |         |   +--rw timezone-name?    string
    |         +--:(timezone-utc-offset)
    |           +--rw timezone-utc-offset? int16
  +--rw ntp
    +--rw use-ntp?      boolean
    +--rw ntp-server [address]
      +--rw address     inet:host

```

### [3.3.](#) DNS Resolver Model

The data model for configuration of the DNS resolver has the following structure:

```

+--rw system
  +--rw dns
    +--rw search*    inet:host
    +--rw server*    inet:ip-address
    +--rw options
      +--rw ndots?    uint8
      +--rw timeout?  uint8
      +--rw attempts? uint8

```

### [3.4.](#) User Authentication Model

This document defines three authentication methods for use with NETCONF:

- o publickey for local users over SSH

- o password for local users over any transport
- o password for RADIUS users over any transport

Additional methods can be defined by other standard documents or by vendors.

This document defines two optional YANG features, "local-users" and "radius", which the server advertises to indicate support for configuring local users on the device, and for configuring RADIUS access, respectively.

The authentication parameters defined in this document are primarily used to configure authentication of NETCONF users, but MAY also be used by other interfaces, e.g., a Command Line Interface or a Web-based User Interface.

The data model for user authentication has the following structure:

```

+--rw system
  +--rw authentication
    +--rw user-authentication-order*  identityref
    +--rw radius
      |   +--rw server [address]
      |   |   +--rw address          inet:host
      |   |   +--rw port?            inet:port-number
      |   |   +--rw shared-secret?   string

```

```
|  +--rw options
|    +--rw timeout?      uint8
|    +--rw attempts?    uint8
+--rw user [name]
  +--rw name              string
  +--rw password?        crypt-hash
  +--rw ssh-dsa?          binary
  +--rw ssh-rsa?          binary
```

#### [3.4.1.](#) SSH Public Key Authentication

If the NETCONF server advertises the "local-users" feature, configuration of local users and their SSH public keys is supported in the /system/authentication/user list.

Public key authentication is requested by the SSH client. If the "local-users" feature is supported, then when a NETCONF client starts an SSH session towards the server using the "publickey" authentication "method name" [[RFC4252](#)], the SSH server looks up the user name given in the SSH authentication request in the /system/authentication/user list, and verifies the key as described in [[RFC4253](#)].

#### [3.4.2.](#) Local User Password Authentication

If the NETCONF server advertises the "local-users" feature, configuration of local users and their passwords is supported in the /system/authentication/user list.

For NETCONF transport protocols that support password authentication, the leaf-list "user-authentication-order" is used to control if local user password authentication should be used.

In SSH, password authentication is requested by the client. Other NETCONF transport protocols MAY also support password authentication.

When local user password authentication is requested, the NETCONF transport looks up the user name provided by the client in the /system/ authentication/user list, and verifies the password.

#### [3.4.3.](#) RADIUS Password Authentication



If the NETCONF server advertises the "radius" feature, the device supports user authentication RADIUS.

For NETCONF transport protocols that support password authentication, the leaf-list "user-authentication-order" is used to control if RADIUS password authentication should be used.

In SSH, password authentication is requested by the client. Other NETCONF transport protocols MAY also support password authentication.

### [3.5.](#) System Control

Two protocol operations are included to restart or shutdown the system. The 'system-restart' operation can be used to restart the entire system (not just the NETCONF server). The 'system-shutdown' operation can be used to power off the entire system.

#### 4. System YANG module

RFC Ed.: update the date below with the date of RFC publication and remove this note.

This YANG module imports YANG extensions from [[I-D.ietf-netconf-access-control](#)], imports YANG types from [[RFC6021](#)], and references [[RFC1321](#)], [[RFC2865](#)], [[RFC3418](#)], [[RFC5607](#)], [[IEEE-1003.1-2008](#)], and [[FIPS.180-3.2008](#)].

```
<CODE BEGINS> file "ietf-system@2011-10-30.yang"
```

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

  import ietf-yang-types {
    prefix yang;
  }

  import ietf-inet-types {
    prefix inet;
  }

  import ietf-netconf-acm {
    prefix nacm;
  }

  organization
    "IETF NETMOD (NETCONF Data Modeling Language) Working Group";

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

     WG Chair:  David Kessens
                <mailto:david.kessens@nsn.com>

     WG Chair:  Juergen Schoenwaelder
                <mailto:j.schoenwaelder@jacobs-university.de>

     Editor:    Andy Bierman
                <mailto:andy.bierman@brocade.com>

     Editor:    Martin Bjorklund
                <mailto:mbj@tail-f.com>";
```

description

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"This module contains a collection of YANG definitions for the configuration and identification of the management system of a device.

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

// RFC Ed.: replace XXXX with actual RFC number and remove this  
// note.

// RFC Ed.: remove this note  
// Note: extracted from [draft-bierman-netmod-system-mgmt-01.txt](#)

// RFC Ed.: update the date below with the date of RFC publication  
// and remove this note.

```
revision 2011-10-30 {  
  description  
    "Initial revision."  
  reference  
    "RFC XXXX: A YANG Data Model for System Management"  
}
```

```
/*  
 * Typedefs  
 */
```

```
typedef crypt-hash {  
  type string {  
    pattern "$0$.* | $1|5|6$[a-zA-Z0-9./]{2,16}$.*";
```

```
}
description
    "The crypt-hash type is used to store passwords using
    a hash function. This type is implemented in various UNIX
    systems as the function crypt(3).
```

When a clear text value is set to a leaf of this type, the server calculates a password hash, and stores the result in the datastore. Thus, the password is never stored in

clear text.

When a leaf of this type is read, the stored password hash is returned.

A value of this type matches one of the forms:

```
$0$<clear text password>
$id>$<salt>$<password hash>
```

The '\$0\$' prefix signals that the value is clear text. When such a value is received by the server, a hash value is calculated, and the string '\$<id>\$<salt>\$' is prepended to the result, where <salt> is a random 2-16 characters long salt used to generate the digest. This value is stored in the configuration data store.

If a value starting with '\$<id>\$<salt>\$' is received, the server knows that the value already represents a hashed value, and stores it as is in the data store.

When a server needs to verify a password given by a user, it finds the stored password hash string for that user, extracts the salt, and calculates the hash with the salt and given password as input. If the calculated hash value is the same as the stored value, the password given by the client is correct.

This type defines the following hash functions:

```
id | hash function | feature
---+-----+-----
```

1	MD5	crypt-hash-md5
5	SHA-256	crypt-hash-sha-256
6	SHA-512	crypt-hash-sha-512

The server indicates support for the different hash functions by advertising the corresponding feature.";

reference

"IEEE Std 1003.1-2008 - crypt() function

Wikipedia: [http://en.wikipedia.org/wiki/Crypt\\_\(Unix\)](http://en.wikipedia.org/wiki/Crypt_(Unix))

[RFC 1321](#): The MD5 Message-Digest Algorithm

FIPS.180-3.2008: Secure Hash Standard";

}

/\*

\* Features

\*/

feature authentication {

description

"Indicates that the device can be configured to do authentication of users.";

}

feature radius {

if-feature authentication;

description

"Indicates that the device can be configured to act as a NAS and authenticate users with RADIUS.";

reference

"[RFC 2865](#): Remote Authentication Dial In User Service (RADIUS)

[RFC 5607](#): Remote Authentication Dial-In User Service (RADIUS) Authorization for Network Access Server (NAS) Management";

}

feature local-users {

if-feature authentication;

description

"Indicates that the device supports local user authentication.";

}

```

feature crypt-hash-md5 {
  description
    "Indicates that the device supports the MD5
    hash function in 'crypt-hash' values";
  reference "RFC 1321: The MD5 Message-Digest Algorithm";
}

```

```

feature crypt-hash-sha-256 {
  description
    "Indicates that the device supports the SHA-256
    hash function in 'crypt-hash' values";
  reference "FIPS.180-3.2008: Secure Hash Standard";
}

```

```

feature crypt-hash-sha-512 {
  description
    "Indicates that the device supports the SHA-512
    hash function in 'crypt-hash' values";
  reference "FIPS.180-3.2008: Secure Hash Standard";
}

```

```

feature ntp {

```

```

  description
    "Indicates that the device can be configured
    to use one or more NTP servers to set the
    system date and time.";
}

feature timezone-location {
  description
    "Indicates that the local timezone on the device
    can be configured to use the TZ database
    to set the timezone and manage daylight savings time.";
  reference
    "TZ Database http://www.twinsun.com/tz/tz-link.htm
    Maintaining the Timezone Database
    http://www.ietf.org/id/draft-lear-iana-timezone-database-04.txt
    ";
}

```

```

feature timezone-name {
  description
    "Indicates that the local timezone on the device
     can be configured using the timezone enumeration
     strings as an alias for an UTC offset.";
  reference
    "Wikipedia: http://en.wikipedia.org/wiki/
    + "List_of_time_zone_abbreviations";
}

/*
 * Identities
 */

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

identity radius {
  base authentication-method;
  description
    "Indicates user authentication using RADIUS.";
  reference
    "RFC 2865: Remote Authentication Dial In User Service (RADIUS)
    RFC 5607: Remote Authentication Dial-In User Service (RADIUS)
    Authorization for Network Access Server (NAS)
    Management";
}

```

```

identity local-users {
  base authentication-method;
  description
    "Indicates password-based authentication of locally
    configured users.";
}

/*
 * Top-level container
 */

```

```

container system {
  description
    "System group configuration.";

  leaf contact {
    type string {
      length "0..255";
    }
    default "";
    reference
      "RFC 3418 - Management Information Base (MIB) for the
        Simple Network Management Protocol (SNMP)
        SNMPv2-MIB.sysContact";
  }

  leaf name {
    type string {
      length "0..255";
    }
    default "";
    reference
      "RFC 3418 - Management Information Base (MIB) for the
        Simple Network Management Protocol (SNMP)
        SNMPv2-MIB.sysName";
  }

  leaf location {
    type string {
      length "0..255";
    }
    default "";
    reference
      "RFC 3418 - Management Information Base (MIB) for the
        Simple Network Management Protocol (SNMP)
        SNMPv2-MIB.sysLocation";
  }
}

```

```

container platform {
  description
    "Contains vendor-specific information for
    identifying the system platform and operating system.";
}

```



```

reference
  "IEEE Std 1003.1-2008 - sys/utsname.h";

config false;

leaf os-name {
  type string;
  description
    "The name of the operating system in use,
    for example 'Linux'";
  reference
    "IEEE Std 1003.1-2008 - utsname.sysname";
}

leaf os-release {
  type string;
  description
    "The current release level of the operating
    system in use. This string MAY indicate
    the OS source code revision.";
  reference
    "IEEE Std 1003.1-2008 - utsname.release";
}

leaf os-version {
  type string;
  description
    "The current version level of the operating
    system in use. This string MAY indicate
    the specific OS build date and target variant
    information.";
  reference
    "IEEE Std 1003.1-2008 - utsname.version";
}

leaf machine {
  type string;
  description
    "A vendor-specific identifier string representing
    the hardware in use.";
  reference
    "IEEE Std 1003.1-2008 - utsname.machine";
}

```

```
    leaf nodename {
      type string;
      description
        "The host name of this system.";
      reference
        "IEEE Std 1003.1-2008 - utsname.nodename";
    }
  }

  container clock {
    description
      "Configuration and monitoring of the system
       date and time properties.";

    leaf current-datetime {
      description
        "The current system date and time.";
      type yang:date-and-time;
      config false;
    }

    leaf boot-datetime {
      description
        "The system date and time when the NETCONF
         server last restarted.";
      type yang:date-and-time;
      config false;
    }
  }

  choice timezone {
    description
      "Configure the system timezone information.";

    leaf timezone-location {
      if-feature timezone-location;
      description
        "The TZ database location identifier string
         to use for the system, such as 'Europe/Stockholm'.";
      type string;
    }

    leaf timezone-name {
      if-feature timezone-name;
      description
        "The timezone enumeration string to use
         for the system, such as 'CET'.";
      type string;
    }
  }
}
```

// FIXME: use TimezoneEnum typedef instead

```
// see http://en.wikipedia.org/wiki/
//      List_of_time_zone_abbreviations
}

leaf timezone-utc-offset {
  description
    "The number of minutes to add to UTC time to
    identify the timezone for this system.
    For example, 'UTC - 8:00 hours' would be
    represented as '-480.'";
  type int16 {
    range "-1439 .. 1439";
  }
}

}

}

container ntp {
  if-feature ntp;

  description
    "Configuration of the NTP client.
    FIXME: should NTP server mode be supported here,
    or in a submodule? Should NTP client and server
    mode be kept together in the same container?";

  leaf use-ntp {
    description
      "Indicates that the system should attempt
      to synchronize the system clock with an
      NTP server from the 'ntp-server' list.";
    type boolean;
    default true;
  }

  list ntp-server {
    description
      "List of NTP servers to use for
      system clock synchronization. If 'use-ntp'
      is 'true', then the system will attempt to
```

```

        contact and utilize the specified NTP servers.";

    key address;

    leaf address {
        description
            "The IP address or domain name of the NTP server.";
        type inet:host;
    }
}

```

```

    }
}

container dns {
    description
        "Configuration of the DNS resolver.";

    leaf-list search {
        type inet:host;
        ordered-by user;
    }
    leaf-list server {
        type inet:ip-address;
        ordered-by user;
        description
            "Addresses of the name servers that the resolver should
            query.

            Implementations MAY limit the number of entries in this
            leaf list.";
    }
    container options {
        description
            "Resolver options. The set of available options has been
            limited to those that are generally available across
            different resolver implementations, and generally useful.";
        leaf ndots {
            type uint8;
            default "1";
        }
        leaf timeout {
            type uint8;
        }
    }
}

```

```

        units "seconds";
        default "5";
    }
    leaf attempts {
        type uint8;
        default "2";
    }
}

container authentication {
    nacm:default-deny-write;
    if-feature authentication;

    description

```

```

    "The authentication configuration subtree.";

    leaf-list user-authentication-order {
        type identityref {
            base authentication-method;
        }
        must '(. = "sys:radius" and ../radius/server) or'
            + '(. != "sys:radius")' {
            error-message
                "When 'radius' is used, a radius server
                must be configured.";
        }
        ordered-by user;

        description
            "When the device authenticates a user with
            a password, it tries the authentication methods in this
            leaf-list in order.  If authentication with one method
            fails, the next method is used.  If no method succeeds,
            the user is denied access.

            If the 'radius' feature is advertised by the NETCONF
            server, the 'radius' 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 radius {
        if-feature radius;
```

```
        description
            "The RADIUS configuration for authentication.";
```

```
        list server {
            key address;
            ordered-by user;
```

```
            description
                "The RADIUS server configuration used by
                 the device.";
```

```
            leaf address {
                type inet:host;
                description
                    "The address of the RADIUS server.";
```

```
    }
    leaf port {
        type inet:port-number;
        default "1812";
        description
            "The port number of the RADIUS server.";
    }
    leaf shared-secret {
        type string;
        nacm:default-deny-all;
        description
            "The shared secret which is known to both the RADIUS
             client and server.";
        reference
            "RFC 2865: Remote Authentication Dial In User Service";
    }
}
container options {
    description
```

```

        "RADIUS client options.";

    leaf timeout {
        type uint8;
        units "seconds";
        default "5";
        description
            "The number of seconds the device will wait for a
             response from a RADIUS server before trying with a
             different server.";
    }
    leaf attempts {
        type uint8;
        default "2";
        description
            "The number of times the device will send a query to
             the RADIUS servers before giving up.";
    }
}

list user {
    if-feature local-users;
    key name;

    description
        "The list of local users configured on this device.";

    leaf name {

```

```

        type string;
        description
            "The user name string identifying this entry.";
    }
    leaf password {
        type crypt-hash;
        description
            "The password for this entry.";
    }
    leaf ssh-dsa {
        type binary;
        description

```

```

        "The public DSA key for this entry.";
    }
    leaf ssh-rsa {
        type binary;
        description
            "The public RSA key for this entry.";
    }
}

rpc set-current-datetime {
    nacm:default-deny-all;
    description
        "Manually set the /system/clock/current-datetime leaf
        to the specified value.

        If the /system/ntp/ntp-in-use leaf exists and
        is set to 'true', then this operation will
        fail with error-tag 'operation-failed',
        and error-app-tag value of 'ntp-active'";
    input {
        leaf current-datetime {
            description
                "The current system date and time.";
            type yang:date-and-time;
            mandatory true;
        }
    }
}

rpc system-restart {
    nacm:default-deny-all;
    description
        "Request that the entire system be restarted immediately.
        A server SHOULD send an rpc reply to the client before

```

```

        restarting the system.";
    }

    rpc system-shutdown {
        nacm:default-deny-all;

```



```
description
  "Request that the entire system be shut down immediately.
   A server SHOULD send an rpc reply to the client before
   shutting down the system.";
}

}
```

<CODE ENDS>

## 5. IANA Considerations

This document registers a URI in the IETF XML registry [[RFC3688](#)]. Following the format in [RFC 3688](#), the following registration is requested to be made.

URI: urn:ietf:params:xml:ns:yang:ietf-system

Registrant Contact: The NETMOD WG of the IETF.

XML: N/A, the requested URI is an XML namespace.

This document registers a YANG module in the YANG Module Names registry [[RFC6020](#)].

name:	ietf-system
namespace:	urn:ietf:params:xml:ns:yang:ietf-system
prefix:	sys
reference:	RFC XXXX

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## [6.](#) Security Considerations

TBD.

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