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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 some common system properties within a device containing a NETCONF server. This includes data node definitions for system identification, time-of-day management, user management, DNS resolver configuration, and some protocol operations for system management.

## Status of this Memo

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## 1. Introduction

This document defines a YANG [[RFC6020](#)] data model for the configuration and identification of some common properties within a device containing a NETCONF server.

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 "ietf-system" YANG module defined in this document provides the following features:

- o system identification configuration and monitoring
- o system time-of-day configuration and monitoring
- o user authentication configuration
- o local users configuration
- o DNS resolver configuration
- o system control operations (shutdown, restart, setting time)

### 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](#)].

### 1.2. Tree Diagrams

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

follows:

- o Brackets "[" and "]" enclose list keys.
- o Abbreviations before data node names: "rw" means configuration (read-write) and "ro" state data (read-only).
- o Symbols after data node names: "?" means an optional node and "\*" denotes a "list" and "leaf-list".
- o Parentheses enclose choice and case nodes, and case nodes are also marked with a colon (":").

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

## [2.](#) 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 state data and the information returned by the server is 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 [[RFC6557](#)] also need to be supported. It should be possible for the server, as well as clients, to configure the system to use NTP.

### [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. It should be possible for the server, as well as clients, to configure the system authentication properties.

### [2.4.](#) DNS Resolver

The configuration of the DNS resolver within the system containing the NETCONF server is required to control how domain names are resolved. An order list of DNS servers and some common parameters such as the list of domains to search when resolving a host name.

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

A few operations are needed to support common tasks such as restarting the device or setting the system date and time.

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

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

The data model for system identification has the following structure:

```
+--rw system
   +--rw contact?          string
```

```

+--rw hostname?          inet:domain-name
+--rw location?           string
+--ro platform
  +--ro os-name?          string
  +--ro os-release?       string
  +--ro os-version?       string
  +--ro machine?          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?  ianatz:iana-timezone
    |     +--:(timezone-utc-offset)
    |       +--rw timezone-utc-offset? int16
  +--rw ntp
    +--rw enabled?    boolean
    +--rw server* [name]
      +--rw name                string
      +--rw (transport)
      | +--:(udp)
      |   +--rw udp
      |     +--rw address      inet:host
      |     +--rw port?       inet:port-number
      +--rw association-type?  enumeration
      +--rw iburst?            boolean
      +--rw prefer?            boolean

```

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

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

```

+--rw system

```



```

+--rw dns-resolver
  +--rw search*      inet:domain-name
  +--rw server* [name]
    | +--rw name      string
    | +--rw (transport)
    | | +--:(udp)
    | |   +--rw udp
    | |     +--rw address      inet:ip-address
    | |     +--rw port?        inet:port-number
  +--rw options
    +--rw timeout?      uint8
    +--rw attempts?     uint8

```

### [3.4.](#) RADIUS Client Model

The data model for configuration of the RADIUS client has the following structure:

```

+--rw system
  +--rw radius
    +--rw server* [name]
      | +--rw name      string
      | +--rw (transport)
      | | +--:(udp)
      | |   +--rw udp
      | |     +--rw address      inet:host
      | |     +--rw authentication-port?  inet:port-number
      | |     +--rw shared-secret      string
      | +--rw authentication-type?  identityref
    +--rw options
      +--rw timeout?      uint8
      +--rw attempts?     uint8

```

### [3.5.](#) 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-authentication", which the server advertises to indicate support for configuring local users on the device, and support for using RADIUS for authentication, 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 user* [name]
      +--rw name          string
      +--rw password?    crypt-hash
      +--rw ssh-key* [name]
        +--rw name          string
        +--rw algorithm     string
        +--rw key-data      binary
```

#### [3.5.1.](#) 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](#)].

#### [3.5.2.](#) 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.

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

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

### [3.6.](#) 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

This YANG module imports YANG extensions from [\[RFC6536\]](#), and imports YANG types from [\[I-D.ietf-netmod-rfc6021-bis\]](#) and [\[I-D.ietf-netmod-iana-timezones\]](#). It also references [\[RFC1321\]](#), [\[RFC2865\]](#), [\[RFC3418\]](#), [\[RFC5607\]](#), [\[IEEE-1003.1-2008\]](#), and [\[FIPS.180-3.2008\]](#).

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

```
<CODE BEGINS> file "ietf-system@2013-06-17.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;
  }

  import iana-timezones {
    prefix ianatz;
  }
}
```

organization

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

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<<mailto:mbj@tail-f.com>>";

description

"This module contains a collection of YANG definitions for the configuration and identification of some common system properties within a device containing a NETCONF server. This includes data node definitions for system identification, time-of-day management, user management, DNS resolver configuration, and some protocol operations for system management.

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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-ietf-netmod-system-mgmt-07.txt

// RFC Ed.: update the date below with the date of RFC publication
// and remove this note.
revision "2013-06-17" {
    description
        "Initial revision.";
    reference
        "RFC XXXX: A YANG Data Model for System Management";
}

/*
 * Typedefs
 */

typedef crypt-hash {
    type string {
        pattern
            '$0$.*'

```

```

+ '|$1$[a-zA-Z0-9./]{1,8}$[a-zA-Z0-9./]{22}'
+ '|$5$(rounds=\d+)$?[a-zA-Z0-9./]{1,16}$[a-zA-Z0-9./]{43}'
+ '|$6$(rounds=\d+)$?[a-zA-Z0-9./]{1,16}$[a-zA-Z0-9./]{86}';
}

```

description

"The crypt-hash type is used to store passwords using a hash function. The algorithms for applying the hash function and encoding the result are implemented in various UNIX systems as the function crypt(3).

A value of this type matches one of the forms:

```

$0$<clear text password>
$id>$<salt>$<password hash>
$id>$<parameter>$<salt>$<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>\$' or \$<id>\$<parameter>\$<salt>\$ is prepended to the result. This value is stored in the configuration data store.

If a value starting with '\$<id>\$', where <id> is not '0', 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 accepted.

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\\_\(C\)](http://en.wikipedia.org/wiki/Crypt_(C))  
[RFC 1321](#): The MD5 Message-Digest Algorithm  
FIPS.180-3.2008: Secure Hash Standard";

```
}
```

```
/*
```

```
 * Features
```

```
 */
```

```
feature radius {
```

```
  description
```

```
    "Indicates that the device can be configured as a RADIUS  
    client.";
```

```
  reference
```

```

    "RFC 2865: Remote Authentication Dial In User Service "
+ "(RADIUS)";
}

feature authentication {
    description
        "Indicates that the device supports configuration
        for user authentication.";
}

feature local-users {
    if-feature authentication;
    description
        "Indicates that the device supports configuration of
        local user authentication.";
}

feature radius-authentication {
    if-feature radius;
    if-feature authentication;
    description
        "Indicates that the device supports configuration of user
        authentication over 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 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 ntp-udp-port {
    description
        "Indicates that the device supports the configuration of
        the UDP port for NTP servers.

        This is a 'feature' since many implementations do not support
        any other port than the default port.";
}

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
        RFC 6557 (BCP 175)";
}

feature dns-udp-port {
    description
        "Indicates that the device supports the configuration of
        the UDP port for DNS servers.

        This is a 'feature' since many implementations do not support
        any other port than the default port.";
}

```

```
}

/*
 * 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.";
}

identity radius-authentication-type {
  description
    "Base identity for RADIUS authentication types.";
}

identity radius-pap {
  base radius-authentication-type;
  description
    "The device requests PAP authentication from the RADIUS"
    "server.";
  reference
    "RFC 2865: Remote Authentication Dial In User Service";
}

identity radius-chap {
  base radius-authentication-type;
  description
    "The device requests CHAP authentication from the RADIUS
```

```
server.";
```

```
reference
  "RFC 2865: Remote Authentication Dial In User Service";
}

/*
 * Top-level container
 */

container system {
  description
    "System group configuration.";

  leaf contact {
    type string;
    description
      "The administrator contact information for the system.
       The server MAY restrict the size and characters in
       order to maintain compatibility with the sysContact
       MIB object.";
    reference
      "RFC 3418 - Management Information Base (MIB) for the
       Simple Network Management Protocol (SNMP)
       SNMPv2-MIB.sysContact";
  }
  leaf hostname {
    type inet:domain-name;
    description
      "The name of the host. This name can be a single domain
       label, or the fully qualified domain name of the host.";
  }
  leaf location {
    type string;
    description
      "The system location. The server MAY restrict the size
       and characters in order to maintain compatibility with
       the sysLocation MIB object.";
    reference
      "RFC 3418 - Management Information Base (MIB) for the
       Simple Network Management Protocol (SNMP)
       SNMPv2-MIB.sysLocation";
  }
}
```

```

}
container platform {
  config false;
  description
    "Contains vendor-specific information for
    identifying the system platform and operating system.";
  reference
    "IEEE Std 1003.1-2008 - sys/utsname.h";

```

```

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

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

```

```

        type yang:date-and-time;
        config false;
        description
            "The system date and time when the system last restarted.";
    }
    choice timezone {
        description
            "The system timezone information.";

        case timezone-location {
            if-feature timezone-location;
            leaf timezone-location {
                type ianatz:iana-timezone;
                description
                    "The TZ database location identifier string
                    to use for the system, such as 'Europe/Stockholm'.";
            }
        }
        case timezone-utc-offset {
            leaf timezone-utc-offset {
                type int16 {
                    range "-1500 .. 1500";
                }
                units "minutes";
                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'.
        Note that automatic daylight savings time adjustment
        is not provided, if this object is used.";
    }
}
}
}

container ntp {
    if-feature ntp;
    description
        "Configuration of the NTP client.";

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

```

```

list server {
    key name;
    description
        "List of NTP servers to use for
        system clock synchronization. If '/system/ntp/enabled'
        is 'true', then the system will attempt to
        contact and utilize the specified NTP servers.";

    leaf name {
        type string;
        description
            "An arbitrary name for the NTP server.";
    }
    choice transport {
        mandatory true;
        description
            "The transport protocol specific parameters for this
            server."
    }
}

```

It is expected that new case statements will be added over time to support other transport protocols."

```

case udp {
  container udp {
    description
      "Contains UDP specific configuration parameters
      for NTP.";
    leaf address {
      type inet:host;
      mandatory true;
      description
        "The address of the NTP server.";
    }
    leaf port {
      if-feature ntp-udp-port;
      type inet:port-number;
      default 123;
      description
        "The port number of the NTP server.";
    }
  }
}
}
leaf association-type {
  type enumeration {
    enum server {
      description
        "Use client association mode. This device
        will not provide synchronization to the

```

```

      configured NTP server.";
    }
    enum peer {
      description
        "Use symmetric active association mode.
        This device may provide synchronization
        to the configured NTP server.";
    }
    enum pool {
      description
        "Use client association mode with one or
        more of the NTP servers found by DNS

```

```

        resolution of the domain name given by
        the 'address' leaf. This device will not
        provide synchronization to the servers.";
    }
}
default server;
description
    "The desired association type for this NTP server.";
}
leaf iburst {
    type boolean;
    default false;
    description
        "Indicates whether this server should enable burst
        synchronization or not.";
}
leaf prefer {
    type boolean;
    default false;
    description
        "Indicates whether this server should be preferred
        or not.";
}
}
}
}

```

```

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

    leaf-list search {
        type inet:domain-name;
        ordered-by user;
        description
            "An ordered list of domains to search when resolving
            a host name.";
    }
}

```

```

}
list server {
    key name;
    ordered-by user;
    description

```



"List of the DNS servers that the resolver should query.

When the resolver is invoked by a calling application, it sends the query to the first name server in this list. If no response has been received within 'timeout' seconds, the resolver continues with the next server in the list. If no response is received from any server, the resolver continues with the first server again. When the resolver has traversed the list 'attempts' times without receiving any response, it gives up and returns an error to the calling application.

Implementations MAY limit the number of entries in this list.";

```
leaf name {
  type string;
  description
    "An arbitrary name for the DNS server.";
}
choice transport {
  mandatory true;
  description
    "The transport protocol specific parameters for this
    server.
```

It is expected that new case statements will be added over time to support other transport protocols.";

```
case udp {
  container udp {
    description
      "Contains UDP specific configuration parameters
      for DNS.";
    leaf address {
      type inet:ip-address;
      mandatory true;
      description
        "The address of the DNS server.";
    }
    leaf port {
      if-feature dns-udp-port;
      type inet:port-number;
      default 53;
```

```

        description
            "The port number of the DNS server.";
    }
}
}
}
}
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 timeout {
        type uint8 {
            range "1..max";
        }
        units "seconds";
        default "5";
        description
            "The amount of time the resolver will wait for a
            response from each remote name server before
            retrying the query via a different name server.";
    }
    leaf attempts {
        type uint8 {
            range "1..max";
        }
        default "2";
        description
            "The number of times the resolver will send a query to
            all its name servers before giving up and returning an
            error to the calling application.";
    }
}
}
}

container radius {
    if-feature radius;

    description
        "Configuration of the RADIUS client.";

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

```

When the RADIUS 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 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 RADIUS server.";
}
choice transport {
  mandatory true;
  description
    "The transport protocol specific parameters
    for this server. It is expected that new
    case statements will be added over time to
    support other transport protocols.";
  case udp {
    container udp {
      description
        "Contains UDP specific configuration parameters
        for RADIUS.";
      leaf address {
        type inet:host;
        mandatory true;
        description
          "The address of the RADIUS server.";
      }
      leaf authentication-port {
        type inet:port-number;
        default "1812";
        description
          "The port number of the RADIUS server.";
      }
    }
    leaf shared-secret {
      type string;
      mandatory true;
```

```

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";
    }
}
}
leaf authentication-type {
    type identityref {
        base radius-authentication-type;
    }
    default radius-pap;
    description
        "The authentication type requested from the RADIUS
        server.";
}
}
container options {
    description
        "RADIUS client options.";

    leaf timeout {
        type uint8 {
            range "1..max";
        }
        units "seconds";
        default "5";
        description
            "The number of seconds the device will wait for a
            response from each RADIUS server before trying with a
            different server.";
    }
    leaf attempts {
        type uint8 {
            range "1..max";
        }
        default "2";
    }
}

```

```

        description
            "The number of times the device will send a query to
              all its RADIUS servers before giving up.";
    }
}
}

```

```

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" or ../../radius/server)' {
        error-message
            "When 'radius' is used, a RADIUS server"
            + " must be configured.";
        description
            "When 'radius' is used as an authentication method,
              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-authentication' 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.";

```

```

}

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.";
  }
  list ssh-key {
    key name;

```

```

  description
    "A list of public SSH keys for this user.";
  reference
    "RFC 4253: The Secure Shell (SSH) Transport Layer
      Protocol";

  leaf name {
    type string;
    description
      "An arbitrary name for the ssh key.";
  }
  leaf algorithm {
    type string;
    mandatory true;
    description
      "The public key algorithm name for this ssh key.

      Valid values are the values in the IANA Secure Shell
      (SSH) Protocol Parameters registry, Public Key
      Algorithm Names";
    reference

```



```
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 one 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 one 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

## 6. Security Considerations

The YANG module defined in this memo is designed to be accessed via the NETCONF protocol [[RFC6241](#)]. The lowest NETCONF layer is the secure transport layer and the mandatory-to-implement secure transport is SSH [[RFC6242](#)]. Authorization for access to specific portions of conceptual data and operations within this module is provided by the NETCONF access control model (NACM) [[RFC6536](#)].

There are a number of data nodes defined in this YANG module which 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:

- o /system/clock/timezone: This choice contains the objects used to control the timezone used by the device.
- o /system/ntp: This container contains the objects used to control the Network Time Protocol servers used by the device.
- o /system/dns-resolver: This container contains the objects used to control the Domain Name System servers used by the device.
- o /system/radius: This container contains the objects used to control the Remote Authentication Dial-In User Service servers used by the device.
- o /system/authentication/user-authentication-order: This leaf controls how user login attempts are authenticated by the device.
- o /system/authentication/user: This list contains the local users enabled on the system.

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

- o /system/platform: This container has objects which may help identify the specific NETCONF server and/or operating system implementation used on the device.
- o /system/authentication/user: This list has objects that may help identify the specific user names and password information in use

on the device.

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

- o set-current-datetime: Changes the current date and time on the device.
- o system-restart: Reboots the device.
- o system-shutdown: Shuts down the device.

## [7.](#) Change Log

-- RFC Ed.: remove this section before publication.

### [7.1.](#) 00-01

- o added configuration-source identities
- o added configuration-source leaf to ntp and dns (via grouping) to choose configuration source
- o added association-type, iburst, prefer, and true leafs to the ntp-server list
- o extended the ssh keys for a user to a list of keys. support all defined key algorithms, not just dsa and rsa
- o clarified timezone-utc-offset description-stmt
- o removed '/system/ntp/server/true' leaf from data model

### [7.2.](#) 01-02

- o added default-stmts to ntp-server/iburst and ntp-server/prefer leafs
- o changed timezone-location leaf to use iana-timezone typedef instead of a string

### [7.3.](#) 02-03

- o removed configuration-source identities and leafs

### [7.4.](#) 03-04

- o removed ndots dns resolver option

- o added radius-authentication-type identity, and identities for pap and chap, and a leaf to control which authentication type to use when communicating with the radius server
- o made 0 an invalid value for timeouts and attempts

#### [7.5.](#) 04-05

- o updated tree diagram explanation text

#### [7.6.](#) 05-06

- o changed ntp/use-ntp to ntp/enabled
- o changed ntp/ntp-server to ntp/server
- o removed /system/platform/nodename leaf
- o changed /system/name to /system/hostname
- o simplified must expression in user-authentication-order
- o added optional rounds to sha hash definition
- o clarified the crypt-hash description
- o clarified ntp descriptions
- o clarified YANG module description to indicate that some system properties are supported, not the entire system
- o clarified that system identification values are vendor specific, not the data node objects
- o clarified sec. 2.2 and 2.3 to indicate that the server should also be capable of configuring these properties
- o changed /system/dns/search from inet:host to inet:domain-name

- o changed [RFC6021](#) reference to 6021-bis
- o changed /system/platform/nodename to /system/platform/hostname
- o changed /system/radius/server/{leafs} to be within a choice and 'udp' case statement so other transport specific parameters can augment this list or they can be added by the WG to a future version of this module. {leafs} are authentication-port and shared-secret.
- o updated YANG tree diagrams for objects added in -05 and -06

#### [7.7.](#) 06-07

- o updated the Abstract and Introduction
- o updated Tree diagram notation

- o identify all external servers (dns, ntp, radius) by name instead of address, in order to make the data model extensible for additional transport protocol.
- o updated the Security Considerations section with a reference to NACM.

## [8.](#) References

### [8.1.](#) Normative References

[FIPS.180-3.2008]

National Institute of Standards and Technology, "Secure Hash Standard", FIPS PUB 180-3, October 2008, <[http://csrc.nist.gov/publications/fips/fips180-3/fips180-3\\_final.pdf](http://csrc.nist.gov/publications/fips/fips180-3/fips180-3_final.pdf)>.

[I-D.ietf-netmod-iana-timezones]

Lange, J., "IANA Timezone Database YANG Module", [draft-ietf-netmod-iana-timezones-00](#) (work in progress), July 2012.

- [I-D.ietf-netmod-rfc6021-bis]  
Schoenwaelder, J., "Common YANG Data Types",  
[draft-ietf-netmod-rfc6021-bis-02](#) (work in progress),  
May 2013.
- [IEEE-1003.1-2008]  
Institute of Electrical and Electronics Engineers,  
"POSIX.1-2008", IEEE Standard 1003.1, March 2008.
- [RFC1321] Rivest, R., "The MD5 Message-Digest Algorithm", [RFC 1321](#),  
April 1992.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate  
Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.
- [RFC2865] Rigney, C., Willens, S., Rubens, A., and W. Simpson,  
"Remote Authentication Dial In User Service (RADIUS)",  
[RFC 2865](#), June 2000.
- [RFC3418] Presuhn, R., "Management Information Base (MIB) for the  
Simple Network Management Protocol (SNMP)", STD 62,  
[RFC 3418](#), December 2002.
- [RFC4252] Ylonen, T. and C. Lonvick, "The Secure Shell (SSH)  
Authentication Protocol", [RFC 4252](#), January 2006.
- [RFC4253] Ylonen, T. and C. Lonvick, "The Secure Shell (SSH)  
Transport Layer Protocol", [RFC 4253](#), January 2006.
- [RFC5607] Nelson, D. and G. Weber, "Remote Authentication Dial-In  
User Service (RADIUS) Authorization for Network Access  
Server (NAS) Management", [RFC 5607](#), July 2009.

- [RFC6020] Bjorklund, M., "YANG - A Data Modeling Language for the  
Network Configuration Protocol (NETCONF)", [RFC 6020](#),  
October 2010.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed.,  
and A. Bierman, Ed., "Network Configuration Protocol  
(NETCONF)", [RFC 6241](#), June 2011.



- [RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", [RFC 6242](#), June 2011.
- [RFC6536] Bierman, A. and M. Bjorklund, "Network Configuration Protocol (NETCONF) Access Control Model", [RFC 6536](#), March 2012.

## [8.2](#). Informative References

- [RFC3688] Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#), January 2004.
- [RFC6557] Lear, E. and P. Eggert, "Procedures for Maintaining the Time Zone Database", [BCP 175](#), [RFC 6557](#), February 2012.

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