
Stream: Internet Engineering Task Force (IETF)
RFC: [10016](#)
Updates: [8342](#)
Category: Standards Track
Published: September 2026
ISSN: 2070-1721
Authors: Q. Ma, Ed. Q. Wu C. Feng
Huawei Huawei

RFC 10016

System-Defined Configuration

Abstract

The Network Management Datastore Architecture (NMDA) in RFC 8342 defines several configuration datastores holding configuration. The contents of these configuration datastores are controlled by clients. This document introduces the concept of a system configuration datastore holding configuration controlled by the system on which a server is running. The system configuration can be referenced (e.g., leafref) by configuration explicitly created by clients.

This document updates RFC 8342.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at <https://www.rfc-editor.org/info/rfc10016>.

Copyright Notice

Copyright (c) 2026 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions

with respect to this document. Code Components extracted from this document must include Revised BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Revised BSD License.

Table of Contents

1. Introduction	3
1.1. Terminology	4
1.2. Requirements Language	5
1.3. Updates to RFC 8342	5
2. Kinds of System Configuration	6
2.1. Always Present	6
2.2. Conditionally Present	6
3. The System Configuration Datastore (<system>)	6
4. Conceptual Model of Datastores	7
5. Static Characteristics	9
5.1. Read-Only to Clients	9
5.2. No Changes to <operational>	9
6. Dynamic Behaviors	9
6.1. May Change via Software Upgrades or Resource Changes	9
6.2. Referencing System Configuration	9
6.3. Overriding System Configuration	10
6.4. Configuring Descendant Nodes of System Configuration	10
7. The "ietf-system-datastore" Module	10
7.1. Data Model Overview	10
7.2. YANG Module	11
7.3. Example Usage	12
8. IANA Considerations	13
8.1. The IETF XML Registry	13
8.2. The YANG Module Names Registry	13
9. Operational Considerations	13

10. Security Considerations	13
10.1. Considerations for the "ietf-system-datastore" YANG Module	13
10.2. Considerations for System Configuration	14
11. References	14
11.1. Normative References	14
11.2. Informative References	15
Appendix A. Example of Dynamic Behaviors (Informative)	16
A.1. Referencing System-Defined Nodes	16
A.2. Modifying a System-Instantiated Leaf's Value	21
A.3. Configuring Descendant Nodes of a System-Defined Node	23
Appendix B. Key Use Cases (Informative)	23
B.1. Device Powers On	24
B.2. Client Commits Configuration	25
B.3. Operator Installs Card into a Chassis	26
B.4. Client Further Commits Configuration	28
Acknowledgements	29
Contributors	30
Authors' Addresses	30

1. Introduction

The Network Management Datastore Architecture (NMDA) [RFC8342] defines system configuration as the configuration that is supplied by the device itself and appears in <operational> when it is in use (see Figure 2 in [RFC8342]).

However, there is a desire from operators to enable a server to better expose the system configuration, regardless of whether it is in use. For example, some implementations define the system configuration that must be referenced to be active. Network Configuration Protocol (NETCONF) / RESTCONF clients can benefit from a standard mechanism to retrieve what system configuration is available on a server.

Some servers allow the descendant nodes of system-defined configuration to be configured or modified. For example, the system configuration may contain an almost empty physical interface, whose existence in the system configuration is tied to the presence of particular

hardware, while the client needs to be able to add, modify, or remove a number of descendant nodes. Some descendant nodes may not be modifiable (e.g., the interface "type" set by the system).

This document updates the NMDA defined in [RFC8342] with a read-only conventional configuration datastore called "system" to expose system-defined configuration. The solution enables configuration explicitly created by the clients to reference nodes defined in <system>, override system-provided values, and configure descendant nodes of system-defined configuration.

The solution defined in this document requires the use of NMDA for both clients and servers. Conformance to this document requires NMDA servers implement the "ietf-system-datastore" YANG module (Section 7).

1.1. Terminology

This document assumes that the reader is familiar with the contents of [RFC6241], [RFC7950], [RFC8342], and [RFC8525] and uses terminologies from those documents. The terms "device" and "server" are used interchangeably in this document.

The following terms are defined in this document:

system configuration:

[RFC8342] defines it as "Configuration that is supplied by the device itself". The definition herein refines that definition to represent configuration present in the system configuration datastore (regardless of whether it is applied or referenced). It may also be referred to as "system-defined configuration" or "system-provided configuration" throughout this document. The system configuration discussed in this document cannot be deletable; configuration provided by the server that is deletable is outside the scope of this document.

system configuration datastore:

This is a configuration datastore holding configuration provided by the system itself. This datastore is referred to as "<system>".

This document redefines the term "conventional configuration datastore" in Section 3 of [RFC8342] to add "system" to the list of conventional configuration datastores:

conventional configuration datastore:

One of the following set of configuration datastores: <running>, <startup>, <candidate>, <system>, and <intended>. These datastores share a common datastore schema, and protocol operations allow copying data between these datastores. The term "conventional" is chosen as a generic umbrella term for these datastores. Note that while protocol operations allow copying data between conventional datastores, the read-only nature of datastores such as <system> and <intended> restricts clients from copying data into them.

system node:

This is an instance in the data tree that is provided by the system itself. System node may also be called "system-defined node" or "system-provided node" throughout this document.

referenced node:

A referenced node is one of the following:

- Targets of leafref values defined via the "path" statement.
- Targets of "instance-identifier" type values.
- Nodes present in an XPath expression of "when" constraints.
- Nodes present in an XPath expression of "must" constraints.
- Nodes defined to satisfy the "mandatory true" constraints.
- Nodes defined to satisfy the "min-elements" constraints.

1.2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

1.3. Updates to RFC 8342

This document updates [RFC8342] to define a configuration datastore called "system" that holds system configuration (Section 3). It also redefines the term "conventional configuration datastore" from [RFC8342] to include "system" in the list.

To ensure the validity of <intended> when clients interact with system configuration (e.g., configuration provided by clients references system configuration) and allow the existence of system-defined templates and inactive system configuration, configuration in <running> is merged with <system> to create the contents of <intended> after the configuration transformations (e.g., template expansion or removal of inactive configuration defined in [RFC8342]) have been performed, as described in Section 4. Specifications in [RFC8342] related to the processing of system configuration are updated by the mechanism defined in this document.

Additionally, this document also updates the definition of the "intended" origin metadata annotation identity defined in Section 5.3.4 of [RFC8342]. The "intended" identity of the origin value defined in [RFC8342] represents the origin of configuration provided by <intended>. This document updates that definition as the origin source of configuration explicitly provided by clients and allows a subset of configuration in <intended> that flows from <system> yet is not configured or overridden explicitly in <running> to use "system" as its origin value. As per Section 5.3.4 of [RFC8342], all configuration with the origin value being reported as "intended" **MUST** originate from <running>, which includes any configuration in <system> that has been copied into <running>. Configuration that is in <system> and not also present in <running> **MUST** be reported as origin "system" in <operational>.

2. Kinds of System Configuration

This document defines two types of system configuration: configuration that is always present and configuration that is conditionally present. These types of system configuration are described in Sections 2.1 and 2.2, respectively.

2.1. Always Present

The always-present system configuration is generated in <system> when the device is powered on, irrespective of whether physical resources are present or whether a special functionality is enabled. An example of an always-present system configuration is an always-existing loopback interface.

2.2. Conditionally Present

The conditionally present system configuration is generated in <system> based on specific conditions being met in a system. For example, if a physical resource is present (e.g., an interface card is inserted), the system automatically detects it and loads the associated configuration; when the physical resource is not present (an interface card is removed), the system configuration will automatically be removed from <system>. Another example is when a special functionality (e.g., a license or feature) is enabled, specific configuration may be created by the system.

3. The System Configuration Datastore (<system>)

Following guidelines for defining datastores in [Appendix A](#) of [\[RFC8342\]](#), this document introduces a new datastore resource named "system" that represents the system configuration. NMDA servers compliant with this document **MUST** implement a system configuration datastore, and they **SHOULD** also implement <intended>.

Name: "system"

YANG modules: all

YANG nodes: all "config true" data nodes up to the root node, generated by the system.

Management operations: The datastore can be read using network management protocols such as NETCONF and RESTCONF, but its contents cannot be changed by management operations via NETCONF and RESTCONF protocols.

Origin: This document does not define any new origin identity. The "system" identity of origin metadata annotation [\[RFC7952\]](#) is used to indicate the origin of a data item provided in <system>.

Protocols: YANG-driven management protocols, such as NETCONF and RESTCONF.

Defining YANG module: "ietf-system-datastore" ([Section 7](#)).

The system configuration datastore does not persist across reboots.

4. Conceptual Model of Datastores

Clients may provide configuration nodes that reference nodes defined in <system>, override system-provided values, and configure descendant nodes of system-defined configuration in <running>, as detailed in [Section 6](#).

To ensure the validity of <intended>, configuration in <running> is merged with <system> to become <intended>, in which process, configuration appearing in <running> takes precedence over the same node in <system>. Since it is unspecified how to merge configuration before transformations, if <system> or <running> includes configuration that requires further transformation (e.g., template expansion or removal of inactive configuration defined in [\[RFC8342\]](#)) before it can be applied, configuration transformations **MUST** be performed independently on each datastore before <running> is merged with <system>.

Whenever configuration in <system> changes, the server **MUST** also immediately update and validate <intended>.

As a result, Figure 2 in [Section 5](#) of [\[RFC8342\]](#) is updated with the below conceptual model of datastores that incorporates the system configuration datastore. For completeness, this model also includes <factory-default> introduced in [\[RFC8808\]](#).

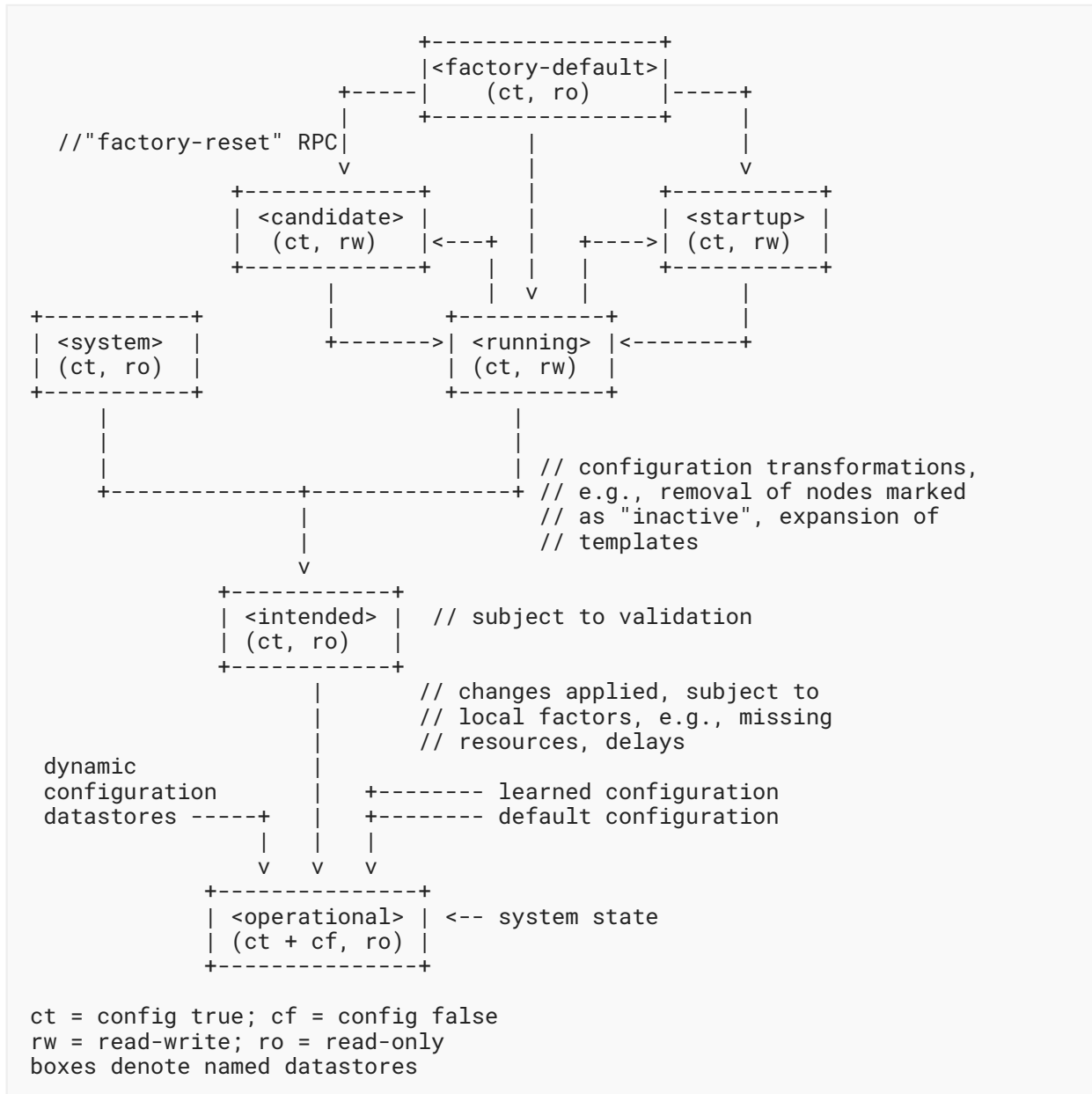


Figure 1: Architectural Model of Datastores

Configuration in `<system>` cannot be deleted by clients (e.g., a list entry can never be removed from `<system>` through protocol operations), even though a node defined in `<system>` may be overridden in `<running>`. If the system initializes a value for a particular leaf that is overridden by the client with a different value in `<running>` (Section 6.3), and if the node in `<running>` is removed at a later time, the system-initialized value defined in `<system>` appears in `<intended>` and may come into use eventually if applied successfully.

Configuration may disappear from <system> due to, e.g., resources no longer available. In such cases, configuration for missing resources can still remain in <running> and <intended>, but it will not be applied and appear in <operational>. This is further clarified in [Section 5.3.2](#) of [\[RFC8342\]](#).

5. Static Characteristics

5.1. Read-Only to Clients

The system datastore is read-only (i.e., edits towards <system> directly **MUST** be denied), though the client may be allowed to provide configuration that overrides the value of a system-initialized node (see [Section 6.3](#)).

5.2. No Changes to <operational>

This work does not change the definition of <operational> nor does it impact the contents of <operational>, as specified in [\[RFC8342\]](#). It clarifies origin reporting, i.e., the origin of nodes sourced from <system> is reported as "system" unless explicitly configured or overridden in <running>. <system> enables system-defined nodes to be defined like configuration, i.e., made visible to clients in order for being referenced or configurable prior to present in <operational>. "config false" nodes are out of scope; hence, existing "config false" nodes are not impacted by this work.

6. Dynamic Behaviors

6.1. May Change via Software Upgrades or Resource Changes

The contents of <system> **MAY** change dynamically under various conditions, such as license change, software upgrade, and system-controlled resources change (see [Section 2.2](#)). The updates of system configuration may be obtained through YANG notifications [\[RFC8639\]](#) [\[RFC8641\]](#) (e.g., on-change notification).

If system configuration changes (e.g., during a software upgrade), <running> **SHOULD** remain a valid configuration data tree. Any mechanisms to achieve this are outside the scope of this document.

6.2. Referencing System Configuration

Clients may create configuration data in <running> that references nodes in <system>. Some implementations may define system nodes solely as a convenience for clients to reference. It is also possible for the clients to define their customized nodes for reference.

[Appendix A.1](#) provides an example of a client referencing system-defined nodes.

6.3. Overriding System Configuration

Although `<system>` is read-only, in some cases, a server may allow some parts of system configuration (e.g., a leaf's value) to be overridden (note the distinction between `<system>` and system configuration). Overriding of system configuration is achieved by the client writing configuration data in `<running>`, which overrides the values of matched configuration nodes at the corresponding level in `<system>`. Configurations defined in `<running>` take precedence over system configuration nodes in `<system>` if the server allows the nodes to be overridden (some implementations may have immutable system configuration that is identified by the server using an immutable metadata annotation; see [YANG-FLAG] for details), regardless of whether a system-instantiated value changes subsequently.

[Appendix A.2](#) provides an example of a client overriding a system-instantiated leaf's value.

6.4. Configuring Descendant Nodes of System Configuration

A server may also allow a client to add nodes to a list entry in `<system>` by writing those additional nodes in `<running>`. Those additional data nodes may not exist in `<system>` (i.e., an addition rather than an override).

[Appendix A.3](#) provides an example of a client configuring descendant nodes of a system-defined node.

7. The "ietf-system-datastore" Module

7.1. Data Model Overview

This YANG module defines a new YANG identity named "system", which uses the "ds:conventional" identity defined in [RFC8342] as its base. A client can discover the system configuration datastore support on the server by reading the YANG library information from the operational state datastore.

The system datastore is defined as a conventional configuration datastore and shares a common datastore schema with other conventional datastores.

The following diagram illustrates the relationship amongst the "identity" statements defined in the "ietf-system-datastore" and "ietf-datastores" YANG modules:

```

Identities:
+--- datastore
| +--- conventional
| | +--- running
| | +--- candidate
| | +--- startup
| | +--- system
| | +--- intended
| +--- dynamic
| +--- operational

```

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

7.2. YANG Module

```

<CODE BEGINS> file "ietf-system-datastore@2026-09-16.yang"

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

  import ietf-datastores {
    prefix ds;
    reference
      "RFC 8342: Network Management Datastore Architecture (NMDA)";
  }

  organization
    "IETF NETMOD (Network Modeling) Working Group";

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

    Author: Qiufang Ma
            <mailto:maqiufang1@huawei.com>
    Author: Qin Wu
            <mailto:bill.wu@huawei.com>
    Author: Chong Feng
            <mailto:fengchonglilly@gmail.com>";

  description
    "This module defines a new YANG identity that uses the
    ds:conventional identity defined in RFC 8342.

    Copyright (c) 2026 IETF Trust and the persons identified
    as authors of the code.  All rights reserved.

    Redistribution and use in source and binary forms, with
    or without modification, is permitted pursuant to, and
    subject to the license terms contained in, the Revised
    BSD License set forth in Section 4.c of the IETF Trust's
    Legal Provisions Relating to IETF Documents
    (https://trustee.ietf.org/license-info).

```

```
    This version of this YANG module is part of RFC 10016
    (https://www.rfc-editor.org/info/rfc10016); see the RFC
    itself for full legal notices.";

    revision 2026-09-16 {
        description
            "Initial version.";
        reference
            "RFC 10016: System-Defined Configuration";
    }

    identity system {
        base ds:conventional;
        description
            "This read-only datastore contains the configuration
            provided by the system itself.";
    }
}
<CODE ENDS>
```

7.3. Example Usage

The following example shows how the configuration in `<system>` could be retrieved in a NETCONF `<get-data>` RPC operation. The example uses the "example-application" fictional data model defined in [Appendix A.1](#) and the Extensible Markup Language (XML) [W3C.XML1.0] encoding.

```
<rpc message-id="101"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get-data xmlns="urn:ietf:params:xml:ns:yang:ietf-netconf-nmda"
    xmlns:syds="urn:ietf:params:xml:ns:yang:ietf-system-datastore">
    <datastore>syds:system</datastore>
    <subtree-filter>
      <applications xmlns="urn:example:application"/>
    </subtree-filter>
  </get-data>
</rpc>
```

When using the RESTCONF protocol, the system configuration datastore can be accessed via the resource: `{+restconf}/ds/ietf-system-datastore:system`. The following example uses an HTTP GET method to request "applications" configuration:

```
GET /restconf/ds/ietf-system-datastore:system/\
  example-application:applications HTTP/1.1
Host: example.com
Accept: application/yang-data+xml
```

8. IANA Considerations

8.1. The IETF XML Registry

IANA has registered the following XML namespace URI in the "ns" registry within the "IETF XML Registry" group [[RFC3688](#)]:

URI: urn:ietf:params:xml:ns:yang:ietf-system-datastore
Registrant Contact: The IESG
XML: N/A; the requested URIs are XML namespaces.

8.2. The YANG Module Names Registry

IANA has registered the following YANG module in the "YANG Module Names" registry within the "YANG Parameters" registry group. [[RFC6020](#)].

Name: ietf-system-datastore
Maintained by IANA? N
Namespace: urn:ietf:params:xml:ns:yang:ietf-system-datastore
Prefix: sysds
Reference: RFC 10016

9. Operational Considerations

System configuration exists regardless of whether the server implements <system> or not. The introduction of <system> provides a standardized way to expose system configuration within NMDA.

NMDA clients that are not aware of <system> will continue to operate correctly. They will interact only with datastores such as <running>, <candidate>, <intended>, and <operational> as before. The presence of <system> does not change the fundamental behavior for such legacy clients. Operators should be aware that to fully leverage the capabilities defined in this document, client applications need to be updated to recognize and interact with <system>.

10. Security Considerations

10.1. Considerations for the "ietf-system-datastore" YANG Module

This section is modeled after the template described in [Section 3.7.1](#) of [[RFC9907](#)].

The "ietf-system-datastore" YANG module defines a data model that is designed to be accessed via YANG-based management protocols, such as the Network Configuration Protocol (NETCONF) [RFC6241] and RESTCONF [RFC8040]. These YANG-based management protocols (1) have to use a secure transport layer and (2) have to use mutual authentication (e.g., Secure Shell (SSH) [RFC4252], TLS [TLS1.3], and QUIC [RFC9000]).

The Network Configuration Access Control Model (NACM) [RFC8341] 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.

The YANG module only defines an identity that uses the "ds:conventional" identity as its base. The module by itself does not expose any sensitive data nodes that are writable or that contain read-only state, and there are no particularly sensitive RPC or action operations. As such, there are no additional security issues related to the YANG module that need to be considered.

10.2. Considerations for System Configuration

The system datastore, while read-only to clients, may contain sensitive information such as hardware identifiers, security policies, and critical system resources. Read access to sensitive system nodes and subtrees within the datastore **MUST** be controlled to prevent unauthorized disclosure. Implementations are strongly advised to log all access attempts to sensitive system configuration for audit purposes.

Furthermore, while <system> cannot be modified directly, system configuration may be overridden as a merging result (Section 6.3). An attacker may configure a leaf that shadows a sensitive node in <system>. Misconfiguration in <running> could lead to unintended system behavior, including security policy bypass and availability risks. Unauthorized modification to sensitive contents **MUST** be prevented to avoid those negative effects on the network.

11. References

11.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", RFC 7950, DOI 10.17487/RFC7950, August 2016, <<https://www.rfc-editor.org/info/rfc7950>>.
- [RFC7952] Lhotka, L., "Defining and Using Metadata with YANG", RFC 7952, DOI 10.17487/RFC7952, August 2016, <<https://www.rfc-editor.org/info/rfc7952>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.

- [RFC8341] Bierman, A. and M. Bjorklund, "Network Configuration Access Control Model", STD 91, RFC 8341, DOI 10.17487/RFC8341, March 2018, <<https://www.rfc-editor.org/info/rfc8341>>.
- [RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "Network Management Datastore Architecture (NMDA)", RFC 8342, DOI 10.17487/RFC8342, March 2018, <<https://www.rfc-editor.org/info/rfc8342>>.

11.2. Informative References

- [RFC3688] Mealling, M., "The IETF XML Registry", BCP 81, RFC 3688, DOI 10.17487/RFC3688, January 2004, <<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC4252] Ylonen, T. and C. Lonvick, Ed., "The Secure Shell (SSH) Authentication Protocol", RFC 4252, DOI 10.17487/RFC4252, January 2006, <<https://www.rfc-editor.org/info/rfc4252>>.
- [RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", RFC 6020, DOI 10.17487/RFC6020, October 2010, <<https://www.rfc-editor.org/info/rfc6020>>.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", RFC 6241, DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", RFC 8040, DOI 10.17487/RFC8040, January 2017, <<https://www.rfc-editor.org/info/rfc8040>>.
- [RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", BCP 215, RFC 8340, DOI 10.17487/RFC8340, March 2018, <<https://www.rfc-editor.org/info/rfc8340>>.
- [RFC8525] Bierman, A., Bjorklund, M., Schoenwaelder, J., Watsen, K., and R. Wilton, "YANG Library", RFC 8525, DOI 10.17487/RFC8525, March 2019, <<https://www.rfc-editor.org/info/rfc8525>>.
- [RFC8639] Voit, E., Clemm, A., Gonzalez Prieto, A., Nilsen-Nygaard, E., and A. Tripathy, "Subscription to YANG Notifications", RFC 8639, DOI 10.17487/RFC8639, September 2019, <<https://www.rfc-editor.org/info/rfc8639>>.
- [RFC8641] Clemm, A. and E. Voit, "Subscription to YANG Notifications for Datastore Updates", RFC 8641, DOI 10.17487/RFC8641, September 2019, <<https://www.rfc-editor.org/info/rfc8641>>.
- [RFC8808] Wu, Q., Lengyel, B., and Y. Niu, "A YANG Data Model for Factory Default Settings", RFC 8808, DOI 10.17487/RFC8808, August 2020, <<https://www.rfc-editor.org/info/rfc8808>>.
- [RFC9000] Iyengar, J., Ed. and M. Thomson, Ed., "QUIC: A UDP-Based Multiplexed and Secure Transport", RFC 9000, DOI 10.17487/RFC9000, May 2021, <<https://www.rfc-editor.org/info/rfc9000>>.

- [RFC9907]** Bierman, A., Boucadair, M., Ed., and Q. Wu, "Guidelines for Authors and Reviewers of Documents Containing YANG Data Models", BCP 216, RFC 9907, DOI 10.17487/RFC9907, March 2026, <<https://www.rfc-editor.org/info/rfc9907>>.
- [TLS1.3]** Rescorla, E., "The Transport Layer Security (TLS) Protocol Version 1.3", RFC 9846, DOI 10.17487/RFC9846, July 2026, <<https://www.rfc-editor.org/info/rfc9846>>.
- [W3C.XML1.0]** Bray, T., Ed., Paoli, J., Ed., Sperberg-McQueen, C.M., Ed., Maler, E., Ed., and F. Yergeau, Ed., "Extensible Markup Language (XML) 1.0 (Fifth Edition)", W3C Recommendation, 26 November 2008, <<https://www.w3.org/TR/2008/REC-xml-20081126/>>. Latest version available at <<https://www.w3.org/TR/xml/>>.
- [YANG-FLAG]** Ma, Q., Ed., Wu, Q., Lengyel, B., Ed., and H. Li, "YANG Metadata Annotation for Immutable Flag", Work in Progress, Internet-Draft, draft-ietf-netmod-immutable-flag-08, 26 February 2026, <<https://datatracker.ietf.org/doc/html/draft-ietf-netmod-immutable-flag-08>>.

Appendix A. Example of Dynamic Behaviors (Informative)

This section presents some sample data models and corresponding contents of various datastores with different dynamic behaviors described in [Section 6](#). The XML snippets are used only for illustration purposes. Note that this section does not show the contents of <intended> as they are related to the configuration in <operational>, assuming the intended configuration is applied successfully. Also note that if the "origin" metadata annotation for configuration is unspecified in snippets, it is inherited from its parent node.

A.1. Referencing System-Defined Nodes

In this subsection, the following fictional module is used:

```
module example-application {
  yang-version 1.1;
  namespace "urn:example:application";
  prefix ex-app;

  import ietf-inet-types {
    prefix inet;
  }
  container applications {
    list application {
      key "name";
      leaf name {
        type string;
      }
      leaf app-id {
        type string;
      }
      leaf protocol {
        type enumeration {
          enum tcp;
          enum udp;
        }
        mandatory true;
      }
      leaf destination-port {
        default "0";
        type inet:port-number;
      }
      leaf description {
        type string;
      }
      container security-protection {
        presence "Indicates that security protection is enabled.";
        leaf risk-level {
          type enumeration {
            enum high;
            enum low;
          }
        }
        //additional leafs for security-specific configuration...
      }
    }
  }
}
```

A fictional Access Control List (ACL) YANG module is used as follows, which defines a leafref for the leaf-list "application" data node to refer to an existing application name.

```
module example-acl {
  yang-version 1.1;
  namespace "urn:example:acl";
  prefix ex-acl;

  import example-application {
    prefix ex-app;
  }

  import ietf-inet-types {
    prefix inet;
  }

  container acl {
    list acl-rule {
      key "name";
      leaf name {
        type string;
      }
      container matches {
        choice l3 {
          container ipv4 {
            leaf src-address {
              type inet:ipv4-prefix;
            }
            leaf dst-address {
              type inet:ipv4-prefix;
            }
          }
        }
        choice applications {
          leaf-list application {
            type leafref {
              path "/ex-app:applications/ex-app:application"
                + "/ex-app:name";
            }
          }
        }
      }
      leaf packet-action {
        type enumeration {
          enum forward;
          enum drop;
          enum redirect;
        }
      }
    }
  }
}
```

The server may predefine some applications as a convenience for clients; these applications are immediately present system configuration. When the device is powered on, the system-instantiated application entries may be present in <system> as follows:

```
<applications xmlns="urn:example:application">
  <application>
    <name>ftp</name>
    <app-id>001</app-id>
    <protocol>tcp</protocol>
    <destination-port>21</destination-port>
    <security-protection>
      <risk-level>low</risk-level>
    </security-protection>
  </application>
  <application>
    <name>tftp</name>
    <app-id>002</app-id>
    <protocol>udp</protocol>
    <destination-port>69</destination-port>
    <security-protection>
      <risk-level>low</risk-level>
    </security-protection>
  </application>
  <application>
    <name>smtp</name>
    <app-id>003</app-id>
    <protocol>tcp</protocol>
    <destination-port>25</destination-port>
    <security-protection>
      <risk-level>low</risk-level>
    </security-protection>
  </application>
</applications>
```

The client may also define customized applications. Those applications may be present in `<running>` as follows:

```
<applications xmlns="urn:example:application">
  <application>
    <name>my-smtp</name>
    <app-id>101</app-id>
    <protocol>tcp</protocol>
    <destination-port>2345</destination-port>
    <description>customized smtp application</description>
    <security-protection>
      <risk-level>high</risk-level>
    </security-protection>
  </application>
  <application>
    <name>my-foo</name>
    <app-id>102</app-id>
    <protocol>udp</protocol>
    <destination-port>1024</destination-port>
    <description>customized application</description>
  </application>
</applications>
```

If a client configures an ACL rule referencing some system-provided or customized applications, the configuration of the ACL rule may be shown as follows:

```
<acl xmlns="urn:example:acl">
  <acl-rule>
    <name>allow-access-to-ftp-tftp</name>
    <matches>
      <ipv4>
        <src-address>198.51.100.0/24</src-address>
        <dst-address>192.0.2.0/24</dst-address>
      </ipv4>
      <application>ftp</application>
      <application>tftp</application>
      <application>my-smtp</application>
    </matches>
    <packet-action>forward</packet-action>
  </acl-rule>
</acl>
```

As different entries of application configuration in <system> and <running> are merged to create <intended>, and there are no merging conflicts in the contents between <system> and <running>, <operational> might contain the configuration of applications with the values of origin reflecting the source of entries as follows:

```
<applications xmlns="urn:example:application"
              xmlns:or="urn:ietf:params:xml:ns:yang:ietf-origin"
              or:origin="or:intended">
  <application>
    <name>my-smtp</name>
    <app-id>101</app-id>
    <protocol>tcp</protocol>
    <destination-port>2345</destination-port>
    <description>customized smtp application</description>
    <security-protection>
      <risk-level>high</risk-level>
    </security-protection>
  </application>
  <application>
    <name>my-foo</name>
    <app-id>102</app-id>
    <protocol>udp</protocol>
    <destination-port>1024</destination-port>
    <description>customized application</description>
  </application>
  <application or:origin="or:system">
    <name>ftp</name>
    <app-id>001</app-id>
    <protocol>tcp</protocol>
    <destination-port>21</destination-port>
    <security-protection>
      <risk-level>low</risk-level>
    </security-protection>
  </application>
  <application or:origin="or:system">
    <name>tftp</name>
    <app-id>002</app-id>
    <protocol>udp</protocol>
    <destination-port>69</destination-port>
    <security-protection>
      <risk-level>low</risk-level>
    </security-protection>
  </application>
  <application or:origin="or:system">
    <name>smtp</name>
    <app-id>003</app-id>
    <protocol>tcp</protocol>
    <destination-port>25</destination-port>
    <security-protection>
      <risk-level>low</risk-level>
    </security-protection>
  </application>
</applications>
```

A.2. Modifying a System-Instantiated Leaf's Value

This subsection uses the following fictional interface YANG module:

```
module example-interface {
  yang-version 1.1;
  namespace "urn:example:interface";
  prefix ex-if;

  import ietf-inet-types {
    prefix inet;
  }

  container interfaces {
    list interface {
      key "name";
      leaf name {
        type string;
      }
      leaf description {
        type string;
      }
      leaf mtu {
        type uint32;
      }
      leaf-list ip-address {
        type inet:ip-address;
      }
    }
  }
}
```

Suppose the system provides an always-present loopback interface (named "lo0") with an MTU value "65536", a default IPv4 address of "127.0.0.1", and a default IPv6 address of "::1". The configuration of the "lo0" interface may be present in <system> as follows:

```
<interfaces xmlns="urn:example:interface">
  <interface>
    <name>lo0</name>
    <mtu>65536</mtu>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
  </interface>
</interfaces>
```

A client modifies the value of MTU to 9216 by adding the following configuration into <running>:

```
<interfaces xmlns="urn:example:interface">
  <interface>
    <name>lo0</name>
    <mtu>9216</mtu>
  </interface>
</interfaces>
```

Since the MTU value provided by the client takes precedence over the system-provided value, and the "origin" value of configuration provided by the client is set to "intended", the configuration of interfaces that is present in <operational> may be as follows:

```
<interfaces xmlns="urn:example:interface"
  xmlns:or="urn:ietf:params:xml:ns:yang:ietf-origin"
  or:origin="or:intended">
  <interface>
    <name>lo0</name>
    <mtu>9216</mtu>
    <ip-address or:origin="or:system">127.0.0.1</ip-address>
    <ip-address or:origin="or:system">::1</ip-address>
  </interface>
</interfaces>
```

A.3. Configuring Descendant Nodes of a System-Defined Node

Based on the example in [Appendix A.2](#), imagine the client further adds the description node of a "lo0" interface in <running> as follows:

```
<interfaces xmlns="urn:example:interface">
  <interface>
    <name>lo0</name>
    <description>loopback</description>
  </interface>
</interfaces>
```

The configuration of interface "lo0" is present in <operational> as follows:

```
<interfaces xmlns="urn:example:interface"
  xmlns:or="urn:ietf:params:xml:ns:yang:ietf-origin"
  or:origin="or:intended">
  <interface>
    <name>lo0</name>
    <description>loopback</description>
    <mtu>9216</mtu>
    <ip-address or:origin="or:system">127.0.0.1</ip-address>
    <ip-address or:origin="or:system">::1</ip-address>
  </interface>
</interfaces>
```

Appendix B. Key Use Cases (Informative)

This section updates the "Interface Example" supplied in [Appendix C.3](#) of [\[RFC8342\]](#).

This section provides several use cases related to how <system> interacts with other datastores (e.g., <candidate>, <running>, <intended>, and <operational>). The following fictional interface data model is used:

```
module example-interface-management {
  yang-version 1.1;
  namespace "urn:example:interfacemgmt";
  prefix ex-ifm;

  import ietf-inet-types {
    prefix inet;
  }

  container interfaces {
    list interface {
      key "name";
      leaf name {
        type string;
      }
      leaf type {
        type enumeration {
          enum ethernet;
          enum atm;
          enum loopback;
        }
      }
      leaf enabled {
        type boolean;
        default "true";
      }
      leaf-list ip-address {
        type inet:ip-address;
      }
      leaf speed {
        when "../type = 'ethernet'";
        type enumeration {
          enum 10Mb;
          enum 100Mb;
        }
      }
      leaf description {
        type string;
      }
    }
  }
}
```

For each use case, corresponding sample configuration in <running>, <system>, <intended>, and <operational> is shown. The XML snippets are used only for illustration purposes.

B.1. Device Powers On

When the device is powered on, assume the system provides an always-present loopback interface named "lo0" that is not explicitly configured in <running>. As a result, no interface configuration appears in <running>, and the content of <system> is as follows:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
</interfaces>
```

In this case, the configuration of loopback interface is only present in <system>, and the configuration of interface in <intended> would be identical to the one in <system> shown above.

In addition, <operational> will show the system-provided loopback interface. Note that <operational> also includes the default value specified in the YANG module:

```
<interfaces xmlns="urn:example:interfacemgmt"
  xmlns:or="urn:ietf:params:xml:ns:yang:ietf-origin"
  or:origin="or:system">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <enabled or:origin="or:default">true</enabled>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
</interfaces>
```

B.2. Client Commits Configuration

If a client creates an interface "et-0/0/0" but the interface does not physically exist at this point, the content of <running> appears as follows:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>et-0/0/0</name>
    <ip-address>192.168.10.10</ip-address>
    <description>pre-provisioned interface</description>
  </interface>
</interfaces>
```

And the content of <system> remains unchanged, only containing the "lo0" loopback interface since the interface "et-0/0/0" is not physically present:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
</interfaces>
```

The content of <intended> represents the merged data of <system> and <running>:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
  <interface>
    <name>et-0/0/0</name>
    <ip-address>192.168.10.10</ip-address>
    <description>pre-provisioned interface</description>
  </interface>
</interfaces>
```

Since the interface named "et-0/0/0" does not exist, the associated configuration is not present in <operational>, which appears as follows:

```
<interfaces xmlns="urn:example:interfacemgmt"
  xmlns:or="urn:ietf:params:xml:ns:yang:ietf-origin"
  or:origin="or:intended">
  <interface or:origin="or:system">
    <name>lo0</name>
    <type>loopback</type>
    <enabled or:origin="or:default">true</enabled>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
</interfaces>
```

B.3. Operator Installs Card into a Chassis

When the interface is installed by the operator, the system will detect it and generate the associated conditionally present interface configuration in <system>. The content of <running> remains unchanged:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>et-0/0/0</name>
    <ip-address>192.168.10.10</ip-address>
    <description>pre-provisioned interface</description>
  </interface>
</interfaces>
```

And <system> might appear as follows:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
  <interface>
    <name>et-0/0/0</name>
    <type>ethernet</type>
    <description>system-defined interface</description>
  </interface>
</interfaces>
```

Then, <intended> contains the merged configuration of <system> and <running>:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
  <interface>
    <name>et-0/0/0</name>
    <type>ethernet</type>
    <ip-address>192.168.10.10</ip-address>
    <description>pre-provisioned interface</description>
  </interface>
</interfaces>
```

And the content of <operational> appears as follows:

```
<interfaces xmlns="urn:example:interfacemgmt"
             xmlns:or="urn:ietf:params:xml:ns:yang:ietf-origin"
             or:origin="or:intended">
  <interface or:origin="or:system">
    <name>lo0</name>
    <type>loopback</type>
    <enabled or:origin="or:default">true</enabled>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
  <interface>
    <name>et-0/0/0</name>
    <type or:origin="or:system">ethernet</type>
    <enabled or:origin="or:default">true</enabled>
    <ip-address>192.168.10.10</ip-address>
    <description>pre-provisioned interface</description>
  </interface>
</interfaces>
```

B.4. Client Further Commits Configuration

If the client further sets the speed of interface "et-0/0/0" in <running>:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>et-0/0/0</name>
    <speed>10Mb</speed>
  </interface>
</interfaces>
```

The content of <system> remains unchanged:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
  <interface>
    <name>et-0/0/0</name>
    <type>ethernet</type>
    <description>system-defined interface</description>
  </interface>
</interfaces>
```

And the content of <intended>, which represents the merged result of <running> and <system>, is as follows:

```
<interfaces xmlns="urn:example:interfacemgmt">
  <interface>
    <name>lo0</name>
    <type>loopback</type>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
  <interface>
    <name>et-0/0/0</name>
    <type>ethernet</type>
    <ip-address>192.168.10.10</ip-address>
    <speed>10Mb</speed>
    <description>pre-provisioned interface</description>
  </interface>
</interfaces>
```

And <operational> would appear as follows:

```
<interfaces xmlns="urn:example:interfacemgmt"
             xmlns:or="urn:ietf:params:xml:ns:yang:ietf-origin"
             or:origin="or:intended">
  <interface or:origin="or:system">
    <name>lo0</name>
    <type>loopback</type>
    <enabled or:origin="or:default">true</enabled>
    <ip-address>127.0.0.1</ip-address>
    <ip-address>::1</ip-address>
    <description>system-defined interface</description>
  </interface>
  <interface>
    <name>et-0/0/0</name>
    <type or:origin="or:system">ethernet</type>
    <enabled or:origin="or:default">true</enabled>
    <ip-address>192.168.10.10</ip-address>
    <speed>10Mb</speed>
    <description>pre-provisioned interface</description>
  </interface>
</interfaces>
```

Acknowledgements

The authors would like to thank the following for discussions and providing input to this document: Balázs Lengyel, Robert Wilton, Jürgen Schönwälder, Andy Bierman, Martin Björklund, Mohamed Boucadair, Michal Vaško, Alexander Clemm, and Timothy Carey.

Contributors

Kent Watsen

Watsen Networks

Email: kent+ietf@watsen.net**Jan Lindblad**

Cisco Systems

Email: jlindbla@cisco.com**Jason Sterne**

Nokia

Email: jason.sterne@nokia.com**Chongfeng Xie**

China Telecom

Beijing

China

Email: xiechf@chinatelecom.cn

Authors' Addresses

Qiufang Ma (EDITOR)

Huawei

101 Software Avenue, Yuhua District

Nanjing

Jiangsu, 210012

China

Email: maqiufang1@huawei.com**Qin Wu**

Huawei

101 Software Avenue, Yuhua District

Nanjing

Jiangsu, 210012

China

Email: bill.wu@huawei.com**Chong Feng**Email: fengchonglly@gmail.com