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## RESTCONF Extensions to Support the Network Management Datastore Architecture

### Abstract

This document extends the RESTCONF protocol defined in RFC 8040 in order to support the Network Management Datastore Architecture (NMDA) defined in RFC 8342.

This document updates RFC 8040 by introducing new datastore resources, adding a new query parameter, and requiring the usage of the YANG library (described in RFC 8525) by RESTCONF servers implementing the NMDA.

### Status of This Memo

This is an Internet Standards Track document.

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## 1. Introduction

This document extends the RESTCONF protocol defined in [RFC8040] in order to support the Network Management Datastore Architecture (NMDA) defined in [RFC8342].

This document updates [RFC8040] in order to enable RESTCONF clients to discover which datastores are supported by the RESTCONF server, determine which modules are supported in each datastore, and interact with all the datastores supported by the NMDA. Specifically, the update introduces new datastore resources, adds a new query parameter, and requires the usage of the YANG library [RFC8525] by RESTCONF servers implementing the NMDA.

The solution presented in this document is backwards compatible with [RFC8040]. This is achieved by only adding new resources and leaving the semantics of the existing resources unchanged.

### 1.1. Terminology

This document uses the terminology defined by the NMDA [RFC8342].

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.

## 2. Datastore and YANG Library Requirements

An NMDA-compliant RESTCONF server **MUST** support the operational state datastore and **MUST** implement at least revision 2019-01-04 of the "ietf-yang-library" module defined in [RFC8525].

Such a server identifies that it supports the NMDA both by implementing the `{+restconf}/ds/ietf-datastores:operational` resource and by implementing at least revision 2019-01-04 of the "ietf-yang-library" module.

A RESTCONF client can test if a server supports the NMDA by using either the HEAD or GET methods on `{+restconf}/ds/ietf-datastores:operational`.

A RESTCONF client can discover which datastores and YANG modules the server supports by reading the YANG library information from the operational state datastore.

### 3. RESTCONF Extensions

This section describes the RESTCONF extensions needed to support the NMDA.

#### 3.1. New Datastore Resources

This document defines a set of new resources representing datastores as defined in [RFC8342]. These resources are available using the following resource path template:

`{+restconf}/ds/<datastore>`

The `<datastore>` path component is encoded as an "identityref" according to the JSON encoding rules for identities, defined in Section 6.8 of [RFC7951]. The namespace-qualified form **MUST** be used. Such an identity **MUST** be derived from the "datastore" identity defined in the "ietf-datastores" YANG module [RFC8342].

Specifically:

- o The resource `{+restconf}/ds/ietf-datastores:operational` refers to the operational state datastore.
- o The resource `{+restconf}/ds/ietf-datastores:running` refers to the running configuration datastore.
- o The resource `{+restconf}/ds/ietf-datastores:intended` refers to the intended configuration datastore.

An NMDA-compliant server **MUST** implement `{+restconf}/ds/ietf-datastores:operational`. Other datastore resources **MAY** be implemented.

YANG actions can only be invoked in `{+restconf}/ds/ietf-datastores:operational`.

As an example, if a server implements a datastore called "ds-ephemeral", defined in a module called "example-ds-ephemeral", then the server would implement the resource `{+restconf}/ds/example-ds-ephemeral:ds-ephemeral`.

### 3.2. Protocol Operations

The protocol operations available for the new datastore resources (see Section 3.1) are the same as the protocol operations defined in [RFC8040] for the `{+restconf}/data` resource with the following exceptions:

- o Dynamic configuration datastores are excluded, as each dynamic configuration datastore definition needs to be reviewed for what protocol operations it supports.
- o Some datastores are read-only by nature (e.g., `<intended>`); hence, any attempt to modify these datastores will fail. A server **MUST** return a response with a "405 Method Not Allowed" status-line and an error-tag value of "operation-not-supported".
- o The semantics of the "with-defaults" query parameter (Section 4.8.9 of [RFC8040]) differ when interacting with the operational state datastore. The semantics are described in Section 3.2.1.
- o [RFC8040], Section 3.5.4, paragraph 3 does not apply when interacting with any resource under `{+restconf}/ds`.

#### 3.2.1. The "with-defaults" Query Parameter on the Operational State Datastore

Support for the "with-defaults" query parameter (Section 4.8.9 of [RFC8040]) is **OPTIONAL** when interacting with `{+restconf}/ds/ietf-datastores:operational`. The associated capability to indicate a server's support is identified with the URI:

`urn:ietf:params:restconf:capability:with-operational-defaults:1.0`

For servers that support it, the behavior of the "with-defaults" query parameter on the operational state datastore is defined as follows:

- o If no "with-defaults" query parameter is specified, or if it is set to "explicit", "report-all", or "report-all-tagged", then the "in use" values, as defined in Section 5.3 of [RFC8342], are returned from the operational state datastore, even if a node happens to have a default statement in the YANG module and this default value is being used by the server. If the "with-defaults" parameter is set to "report-all-tagged", any values that match the schema default are tagged with additional metadata, as described in Section 4.8.9 of [RFC8040].

- o If the "with-defaults" query parameter is set to "trim", all "in use" values are returned, except that the output is filtered to exclude any values that match the default defined in the YANG schema.

Servers are not required to support all values in the "with-defaults" query parameter on the operational state datastore. If a request is made using a value that is not supported, then the error handling behavior is as described in Section 4.8.9 of [RFC8040].

### 3.2.2. New "with-origin" Query Parameter

A new query parameter named "with-origin" is added to the GET operation. If present, it requests that the server includes "origin" metadata annotations in its response, as detailed in the NMDA. This parameter is only valid when querying `{+restconf}/ds/ietf-datastores:operational` or any datastores with identities derived from the "operational" identity. Otherwise, if an invalid datastore is specified, then the server MUST return a response with a "400 Bad Request" status-line, using an error-tag value of "invalid-value". "origin" metadata annotations are not included unless a client explicitly requests them.

Data in the operational state datastore can come from multiple sources. The server should return the "origin" metadata annotation value that most accurately indicates the source of the operational value, as specified in Section 5.3.4 of [RFC8342].

When encoding the "origin" metadata annotation for a hierarchy of returned nodes, the annotation can be omitted for a child node when the value matches that of the parent node, as described in the "ietf-origin" YANG module [RFC8342].

Support for the "with-origin" query parameter is OPTIONAL. It is identified with the URI:

`urn:ietf:params:restconf:capability:with-origin:1.0`

#### 4. IANA Considerations

This document defines two capability identifier URNs in the "RESTCONF Capability URNs" registry defined in [RFC8040]:

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Capability Identifier  
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:with-origin  
urn:ietf:params:restconf:capability:with-origin:1.0

:with-operational-defaults  
urn:ietf:params:restconf:capability:with-operational-defaults:1.0

#### 5. Security Considerations

This document extends the RESTCONF protocol by introducing new datastore resources. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [RFC8446]. The RESTCONF protocol uses the network configuration access control model [RFC8341], which provides the means to restrict access for particular RESTCONF users to a preconfigured subset of all available RESTCONF protocol operations and content.

The security constraints for the base RESTCONF protocol (see Section 12 of [RFC8040]) apply to the new RESTCONF datastore resources defined in this document.

#### 6. Normative References

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