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Terminology and Requirements for Enhanced Handling of Operational State
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Abstract

   This document primarily regards the difference between the intended
   configuration and the applied configuration of a device and how
   intended and applied configuration relate to the operational state of
   a device. This document defines requirements for the applied
   configuration's data model and its values, as well as for enabling a
   client to know when a configuration has been fully applied or not,
   how to access operational state, and how to relate intended
   configuration nodes to applied configuration and derived state nodes.

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1. Introduction

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   configuration and the applied configuration of a device and how
   intended and applied configuration relate to the operational state of
   a device. This document defines requirements for the applied
   configuration's data model and its values, as well as for enabling a
   client to know when a configuration has been fully applied or not,
   how to access operational state, and how to relate intended
   configuration nodes to applied configuration and derived state nodes.

2. Terminology

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
   document are to be interpreted as described in RFC 2119 [RFC2119].

   The term "client" is used throughout this document to refer to what
   is many times known as the "application" or "network management
   system". This definition is intended to be consistent with the term
   "client" defined in [RFC6241], Section 1.1, but independent of any
   association to a particular protocol.

   The term "server" is used throughout this document to refer to what
   is many times known as the "device", "system", or "network element".
   This definition is intended to be consistent with the term "server"
   defined in [RFC6241], Section 1.1, but independent of any association
   to a particular protocol.

This document defines the following terms:

Applied Configuration: This data represents the configuration state
    that the server is actually in. That is, the configuration state
    which is currently being used by server components (e.g., control
    plane daemons, operating system kernels, line cards). With
    respect to NETCONF architecture, the applied configuration
    resides in the "system software component" box listed on page 15
    of [RFC6244]

       NOTE: The server's ability to report applied configuration
       accurately may be limited in some cases, such as when the
       configuration goes through an intermediate layer without an
       ability to inspect the lower layer.

Asynchronous Configuration Operation: A configuration request to
    update the running configuration of a server that is applied
    asynchronously with respect to the client request. The server
    MUST update its intended configuration (see term) before replying
    to the client indicating whether the request will be processed.
    This reply to the client only indicates whether there are any
    errors in the original request. The server's applied
    configuration state (see term) is updated after the configuration
    change has been fully effected to all impacted components in the
    server. Once applied, there MUST be a mechanism for the client
    to determine when the request has completed processing and
    whether the intended config is now fully effective or there are
    any errors from applying the configuration change, which could be
    from an asynchronous notification or via a client operation.

Derived State: This data represents information which is generated
    as part of the server's own interactions. For example, derived
    state may consist of the results of protocol interactions (the
    negotiated duplex state of an Ethernet link), statistics (such as
    message queue depth), or counters (such as packet input or output
    bytes).

Intended Configuration: This data represents the configuration state
    that the network operator intends the server to be in, and that
    has been accepted by the server as valid configuration. With
    respect to NETCONF architecture, the intended configuration is
    captured by the "config database" box listed on page 15 of
    [RFC6244]

Operational State: Operational State is the current state of the
    system as known to the various components of the system (e.g.,
    control plane daemons, operating system kernels, line cards).

The operational state includes both applied configuration and derived state.

Synchronous Configuration Operation: A configuration request to update the running configuration of a server that is applied synchronously with respect to the client request (i.e. a blocking call). The server MUST fully attempt to apply the configuration change to all impacted components in the server, updating both the server's intended and applied configuration (see terms), before replying to the client. The reply to the client indicates whether there are any errors in the request or errors from applying the configuration change.

3. Backwards Compatibility

Any solution satisfying the requirements specified in this document MUST ensure backwards compatibility with regards to existing deployments. Specifically, it MUST be possible to upgrade a server to one that supports the solution without breaking existing/legacy clients. Likewise, it MUST be possible for a client that has been coded to support the solution to interoperate appropriately with existing/legacy servers.

4. Requirements

1. Ability to interact with both intended and applied configuration

    A. The ability to ask the operational components of a server (e.g., line cards) for the configuration that they are currently using. This is the applied configuration (see term).

    B. Applied configuration is read-only

    C. The data model for the applied configuration is the same as the data model for the intended configuration (same leaves)

    D. When a configuration change for any intended configuration node has been successfully applied to the server (e.g. not failed, nor deferred due to absent hardware) then the existence and value of the corresponding applied configuration node must match the intended configuration node.

2. Support for both synchronous and asynchronous configuration operations (see terms)

      A. A server may support only synchronous configuration
          operations, or only asynchronous configuration operations, or
          both synchronous and asynchronous configuration operations on
          a client-specified per-operation basis.

      B. Servers that support asynchronous configuration operations
          MAY also provide a verify operation that a client can request
          from the server to return information regarding the
          difference between the intended and applied configurations.

      C. The configuration protocol MUST specify how configuration
          errors are handled. Errors MAY be handled by semantics
          similar to NETCONF's error-options for the <edit-config>
          operation (stop-on-error, continue-on-error, rollback-on-
          error), as described in Section 7.2 in [RFC6241], but
          extended to incorporate both the intended and applied
          configurations. Support for "rollback on error" semantics
          SHOULD be provided.

   3. Separation of the applied configuration and derived state aspects
      of operational state; ability to retrieve them independently and
      together

      A. Be able to retrieve only the applied configuration aspects of
          operational state

      B. Be able to retrieve only the derived state aspects of
          operational state

      C. Be able to retrieve both the applied configuration and
          derived state aspects of operational state together

   4. Ability to relate configuration with its corresponding
      operational state

      A. Ability to map intended config nodes to corresponding applied
          config nodes

      B. Ability to map intended config nodes to associated derived
          state nodes

      C. The mappings needs to be programmatically consumable

5. Security Considerations

   It is understood that the intended and applied configurations will
   differ while synchronization is in progress. During the
   synchronization process, the server will be in an inconsistent state

from the client's perspective. Implementations need to take care to
ensure that this process minimizes gaps in the application of
security policy (e.g., replacing a firewall policy in a single step).
Implementations additionally need to ensure that any gaps in security
policies are not dependent on external input that an attacker might
be able to control or prevent access to.

6. IANA Considerations

None

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8.1. Normative References

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