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Partial Lock RPC for NETCONF
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Abstract

The NETCONF protocol defines the lock and unlock RPCs that lock entire configuration datastores. In some situations, a way to lock only parts of a configuration datastore is required. This document defines a capability-based extension to the NETCONF protocol for locking portions of a configuration datastore.

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August 2007

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1. Introduction

The NETCONF protocol [[RFC4741](#)] describes the lock and unlock RPCs that operate on entire configuration datastores. Often, multiple management sessions need to be able to modify the configuration of a managed device in parallel. In these cases, locking only parts of a configuration datastore is needed. This document defines an extension to the NETCONF protocol to allow this.

The mechanism for partial locking will be based on the existing XPath filtering mechanisms.

Partial locking will be introduced as a capability to NETCONF.

1.1. Definition of Terms

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](#).

2. Partial Locking Capability

2.1. Overview

The `:partial-locking` capability indicates that the device supports the locking of its configuration with a scope smaller than a complete configuration datastore. Partial locking covers configuration data, but not state data.

The system will ensure that configuration resources covered by the lock will not be modified by other NETCONF or non-NETCONF management operations such as SNMP and the CLI.

The duration of the partial lock is defined as beginning when the partial lock is granted and lasting until either the corresponding

<partial-unlock> operation succeeds or the NETCONF session terminates.

A NETCONF session MAY have multiple parts of one or more datastores locked using partial lock operations. The <partial-lock> operation returns a lock-id to identify each successfully acquired lock.

[2.2.](#) Dependencies

If the :xpath capability is supported, the filter expressions can be full XPath 1.0 expressions.

[2.3.](#) Capability Identifier

urn:ietf:params:netconf:capability:partial-lock:1.0

[2.4.](#) New Operations

[2.4.1.](#) <partial-lock>

The <partial-lock> operation allows the client to lock a portion of a data store. The portion to lock is specified by using XPath filter parameters in the <partial-lock> operation. Each XPath expression MUST return a node set. A <partial-lock> operation MUST be handled atomically by the NETCONF server. The server either locks all requested parts of the data store or none.

The XPath filter expressions are evaluated only once at lock time. If the configuration data is altered later in a way that would make the original XPath filter expressions evaluate to a different set of nodes, this does not affect the scope of the partial lock.

If a node is locked by a session, only that same session will be able to modify that node or any node in the subtree underneath it.

If a top level node of a locked subtree is deleted, any other session can recreate it, as it is not covered by the lock anymore.

A partial lock MUST fail if:

- o Any part of the scope to be locked is already locked by another

management session/protocol, including other NETCONF sessions using the (global) <lock> operation or <partial-lock> or any other non-NETCONF management method.

- o The locking user does not have at least some basic access rights, e.g., read rights, to all of the datastore section to be locked. The exact handling of access rights is outside the scope of this document, but it is assumed that there is an access control system that MAY deny or allow the partial lock operation.

As with most locking systems, there is a possibility that two users trying to lock different parts of the configuration become dead-locked. To avoid this situation, clients SHOULD lock everything they need in one operation. If that operation still fails, the client SHOULD back down, release any already acquired locks, and retry the procedure after some time interval. The length of the interval should preferably be random to avoid repeated dead-locks when both (or all) clients back down and then repeat locking.

Parameters:

target: Name of the configuration datastore of which a part will be locked. URIs are not accepted.

filter: The filter element contains a 'select' attribute, which contains an XPath expression. The XPath expression is evaluated in a context where the context node is the root of the server's conceptual data model, and the set of namespace declarations are those in scope on the filter element.

The filter MUST return a node set.

If the device does not support the :xpath capability, the XPath expression MUST be limited to an Instance Identifier expression [Editor's Note: add text or reference. An Instance Identifier is an absolute path expression in abbreviated syntax, where predicates are used only to specify values for nodes defined as keys to distinguish multiple instances.]

Example: Lock virtual router 1 and interface eth1

```

<nc:rpc
  xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns="urn:ietf:params:netconf:capability:partial-lock:1.0"
  xmlns:rte="http://example.com/ns/route">
  xmlns:if="http://example.com/ns/interface">
  nc:message-id="135">
    <partial-lock>
      <nc:running/>
      <filter select="/rte:routing/rte:virtualRouter[rte:id='1']"/>
      <filter select="/if:interfaces/[if:interfaceId='eth1']"/>
    </partial-lock>
  </nc:rpc>

<nc:rpc-reply
  xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns="urn:ietf:params:netconf:capability:partial-lock:1.0"
  xmlns:rte="http://example.com/ns/route">
  xmlns:if="http://example.com/ns/interface">
  nc:message-id="135">
    <nc:data>
      <lock-id>127</lock-id>
    </nc:data>
  </nc:rpc-reply>

```

Positive Response:

If the device was able to satisfy the request, an <rpc-reply> is sent with a <lock-id> element (lock identifier) in the <data> element.

Negative Response:

If a lock is already held on any node within the subtrees to be locked, the <error-tag> element will be 'lock-denied' and the <error-info> element will include the <session-id> of the lock owner. If the lock is held by a non-NETCONF entity, a <session-id> of 0 (zero) is included.

If the filters return an empty node set, the <error-tag> will be 'operation-failed', and the <error-app-tag> will be 'no-matches'.

If any filter returns anything but a node set, the <error-tag> will be 'invalid-value'.

If the :xpath capability is not supported and the XPath expression is not an Instance Identifier, the <error-tag> will be 'invalid-value'.

If access control denies the partial lock, the <error-tag> will be 'access-denied'.

[2.4.2.](#) <partial-unlock>

The operation unlocks a part of a datastore that was previously locked using <partial-lock> during the same session.

Parameters:

lock-id: Lock identifier to unlock; taken from a reply to a previous <partial-lock> operation.

Example: Unlock

```
<nc:rpc xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns="urn:ietf:params:netconf:capability:partial-lock:1.0"
  nc:message-id="136">
  <partial-unlock>
    <lock-id>127</lock-id>
  </partial-unlock>
</nc:rpc>
```

Positive Response:

If the device was able to satisfy the request, an <rpc-reply> is sent that contains an <ok> element. A positive response MUST be sent even if all of the locked part of the datastore has already been deleted.

Negative Response:

If the <lock-id> parameter does not identify a lock which is owned by the session, an 'invalid-value' error is returned.

[2.5.](#) Modifications to Existing Operations

None.

[2.6.](#) Interactions with Other Capabilities

[2.6.1.](#) Writable-Running Capability

Partial locking of the running datastore can only be done if the :writable-running capability is supported by the device.

[2.6.2.](#) Candidate Configuration Capability

Partial locking of the candidate datastore can only be done if the :candidate capability is supported by the device. The partial locking of the candidate datastore does not depend on whether the datastore was modified or not.

[2.6.3.](#) Distinct Startup Capability

Partial locking of the startup datastore can only be done if the :startup capability is supported by the device.

[3.](#) Security Considerations

The same considerations as for the base NETCONF Protocol [[RFC4741](#)] are valid. It is assumed that the <partial-lock> and <partial-unlock> RPCs are only allowed for an authenticated user after passing some access control mechanism.

[4.](#) IANA Considerations

The capability's URI should be registered by IANA.

[5.](#) Change Log

[5.1.](#) Open Issues

Shall we allow the locking of non-existent nodes? The operator might want to reserve an object or rather its key/name even if he will create the object later.

Should we include more detailed information in error results to help debug lock conflicts, e.g. the `userId` of the conflicting session, the XPATH expression of the conflicting session, the `instanceId` of the first object where the lock conflict was found?

Should we allow users to lock parts of multiple datastores (e.g. `/top/routing` both in the candidate and the running datastore) in one operation? This would decrease the probability of a deadlock, but currently the (global) `<lock>` operation doesn't support this.

[6.](#) XML Schema for Partial Locking

The following XML Schema defines the `<partial-lock>` and `<partial-unlock>` operations:

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns="urn:ietf:params:netconf:capability:partial-lock:1.0"
  xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"
  targetNamespace="urn:ietf:params:netconf:capability:partial-lock:1.0"
  elementFormDefault="qualified" attributeFormDefault="unqualified">

  <xs:annotation>
    <xs:documentation>
      Schema defining the partial-lock and unlock operations.
    </xs:documentation>
  </xs:annotation>

  <xs:import namespace="urn:ietf:params:xml:ns:netconf:base:1.0"
    schemaLocation="urn:ietf:params:xml:ns:netconf:base:1.0"/>

  <xs:complexType name="filterType">
    <xs:complexContent>
      <xs:extension base="xs:anyType">
        <xs:attribute name="select" use="required"/>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
</xs:schema>
```

```
</xs:complexContent>
</xs:complexType>

<xs:complexType name="partialLockType">
  <xs:complexContent>
    <xs:extension base="nc:rpcOperationType">
      <xs:sequence>
        <xs:element ref="nc:config-name"/>
        <xs:element name="filter" type="filterType"
          maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>

<xs:complexType name="partialUnLockType">
  <xs:complexContent>
    <xs:extension base="nc:rpcOperationType">
      <xs:sequence>
        <xs:element name="lock-id" type="xs:unsignedInt"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>

<!-- <partial-lock> operation -->
<xs:element name="partial-lock" type="partialLockType"
  substitutionGroup="nc:rpcOperation"/>

<!-- <partial-unlock> operation -->
<xs:element name="partial-unlock" type="partialUnLockType"
  substitutionGroup="nc:rpcOperation"/>

<!-- reply to <partial-lock> -->
<xs:element name="lock-id" type="xs:unsignedInt"/>

</xs:schema>
```

[7.](#) Acknowledgements

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[8.](#) Normative References

[RFC4741] "NETCONF Configuration Protocol", [RFC 4741](#), December 2006.

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