
NCClient Documentation

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INTRODUCTION

NCClient is a Python library for NETCONF clients. NETCONF is a network management protocol defined in [RFC 4741](#).

It is meant for Python 2.6+ (not Python 3 yet, though).

The features of NCClient include:

- Request pipelining.
- (A)synchronous RPC requests.
- Keeps XML out of the way unless really needed.
- Supports all operations and capabilities defined in [RFC 4741](#).
- Extensible. New transport mappings and capabilities/operations can be easily added.

The best way to introduce is of course, through a simple code example:

```
from ncclient import manager

# use ssh-agent or ~/.ssh keys for auth, load known_hosts by default
with manager.connect_ssh('host', username='username') as m:
    assert(":url" in manager.server_capabilities)
    with m.locked('running'):
        m.copy_config(source="running", target="file://new_checkpoint.conf")
        m.copy_config(source="file://old_checkpoint.conf", target="running")
```

It is recommended to use the high-level Manager API where possible. It exposes all of the functionality except asynchronous RPC requests.

USER DOCUMENTATION

2.1 manager module

2.1.1 Dealing with RPC errors

These constants define what `Manager` does when an `<rpc-error>` element is encountered in a reply.

RAISE_ALL

Raise all `RPCError`

RAISE_ERR

Only raise when `error-severity` is “error” i.e. no warnings

RAISE_NONE

Don’t raise any

2.1.2 Manager instances

`Manager` instances are created by the `connect()` family of factory functions. Currently only `connect_ssh()` is available.

connect (*args, **kws)

Same as `connect_ssh()`

connect_ssh (*args, **kws)

Connect to NETCONF server over SSH. See `SSHSession.connect()` for function signature.

class Manager (*session*)

API for NETCONF operations. Currently only supports making synchronous RPC requests.

It is also a context manager, so a `Manager` instance can be used with the `with` statement. The session is closed when the context ends.

set_rpc_error_action (*action*)

Specify the action to take when an `<rpc-error>` element is encountered.

Parameter *action* – one of `RAISE_ALL`, `RAISE_ERR`, `RAISE_NONE`

get (*args, **kws)

See `Get.request()`

get_config (*args, **kws)

See `GetConfig.request()`

edit_config (*args, **kws)

See `EditConfig.request()`

copy_config (*args, **kws)

See `CopyConfig.request()`

validate (*args, **kws)

See `GetConfig.request()`

commit (**args*, ***kws*)

See `Commit.request()`

discard_changes (**args*, ***kws*)

See `DiscardChanges.request()`

delete_config (**args*, ***kws*)

See `DeleteConfig.request()`

lock (**args*, ***kws*)

See `Lock.request()`

unlock (**args*, ***kws*)

See `DiscardChanges.request()`

close_session (**args*, ***kws*)

See `CloseSession.request()`

kill_session (**args*, ***kws*)

See `KillSession.request()`

locked (*target*)

 Returns a context manager for the *with* statement.

Parameter *target* (*string*) – name of the datastore to lock

Return type `LockContext`

close ()

 Closes the NETCONF session. First does `<close-session>` RPC.

client_capabilities

`Capabilities` object for client

server_capabilities

`Capabilities` object for server

session_id

`<session-id>` as assigned by NETCONF server

connected

 Whether currently connected to NETCONF server

2.2 capabilities module

CAPABILITIES

`Capabilities` object representing the capabilities currently supported by NCClient

class `Capabilities` (*capabilities*)

Represents the set of capabilities for a NETCONF client or server. Initialised with a list of capability URI's.

Presence of a capability can be checked with the *in* operations. In addition to the URI, for capabilities of the form `urn:ietf:params:netconf:capability:$name:$version` their shorthand can be used as a key. For example, for `urn:ietf:params:netconf:capability:candidate:1.0` the shorthand would be `:candidate`. If version is significant, use `:candidate:1.0` as key.

add (*uri*)

 Add a capability

check (*key*)

 Whether specified capability is present.

Parameter *key* – URI or shorthand

remove (*uri*)

 Remove a capability

2.3 xml_ module

The `xml` module provides methods for creating XML documents, parsing XML, and converting between different XML representations. It uses `ElementTree` internally.

2.3.1 Namespaces

The following namespace is defined in this module.

BASE_NS

Base NETCONF namespace

Namespaces are handled just the same way as `ElementTree`. So a qualified name takes the form `{namespace}tag`. There are some utility functions for qualified names:

qualify (*tag*, [*ns=BASE_NS*])

Returns qualified name

unqualify (*tag*)

Returns unqualified name

Note: It is strongly recommended to compare qualified names.

2.3.2 DictTree XML representation

Note: Where this representation is stipulated, an XML literal or `Element` is just fine as well.

`ncclient` can make use of a special syntax for XML based on Python dictionaries. It is best illustrated through an example:

```
dtree = {
    'tag': qualify('a', 'some_namespace'),
    'attrib': {'attr': 'val'},
    'subtree': [ { 'tag': 'child1' }, { 'tag': 'child2', 'text': 'some text' } ]
}
```

Calling `dtree2xml()` on `dtree` would return

```
<?xml version="1.0" encoding="UTF-8"?>
<ns0:a attr="val" xmlns:ns0="some_namespace">
  <child1 />
  <child2>some text</child2>
</ns0:a>
```

In addition to a 'pure' dictionary representation a DictTree node (including the root) may be an XML literal or an `Element` instance. The above example could thus be equivalently written as:

```
dtree2 = {
    'tag': '{ns}a',
    'attrib': {'attr': 'val'},
    'subtree': [ ET.Element('child1'), '<child2>some text</child2>' ]
}
```

2.3.3 Converting between different representations

Conversions *to* DictTree representation are guaranteed to be entirely dictionaries. In converting *from* DictTree representation, the argument may be any valid representation as specified.

dtree2ele (*spec*)

DictTree -> Element

Return type Element

dtree2xml (*spec*, [*encoding*="UTF-8"])

DictTree -> XML

Parameter *encoding* – character encoding

Return type string

ele2dtree (*ele*)

DictTree -> Element

Return type dict

ele2xml (*ele*)

Element -> XML

Parameter *encoding* – character encoding

Return type string

xml2dtree (*xml*)

XML -> DictTree

Return type dict

xml2ele (*xml*)

XML -> Element

Return type Element

2.3.4 Other utility functions

iselement (*obj*)

See `xml.etree.ElementTree.iselement()`

find (*ele*, *tag*, [*nslist*=, []])

If *nslist* is empty, same as `xml.etree.ElementTree.Element.find()`. If it is not, *tag* is interpreted as an unqualified name and qualified using each item in *nslist* (with a `None` item in *nslist* meaning no qualification is done). The first match is returned.

Parameter *nslist* – optional list of namespaces

parse_root (*raw*)

Efficiently parses the root element of an XML document.

Parameter *raw* (string) – XML document

Returns a tuple of (*tag*, *attributes*), where *tag* is the (qualified) name of the element and *attributes* is a dictionary of its attributes.

Return type tuple

validated_element (*rep*, *tag*=None, *attrs*=None, *text*=None)

Checks if the root element meets the supplied criteria. Returns a `Element` instance if so, otherwise raises `ContentError`.

Parameters • *tags* – tag name or a list of allowable tag names

- *attrs* – list of required attribute names, each item may be a list of allowable alternatives
- *text* – textual content to match

2.3.5 Errors

exception `ContentError`

Bases: `ncclient.NCClientError`

Raised by methods of the `content` module in case of an error.

2.4 transport module

2.4.1 Base types

class `Session` (*capabilities*)

Base class for use by transport protocol implementations.

`add_listener` (*listener*)

Register a listener that will be notified of incoming messages and errors.

`remove_listener` (*listener*)

Unregister some listener; ignore if the listener was never registered.

`get_listener_instance` (*cls*)

If a listener of the specified type is registered, returns the instance.

`client_capabilities`

Client's Capabilities

`server_capabilities`

Server's Capabilities

`connected`

Connection status of the session.

`id`

A `string` representing the `session-id`. If the session has not been initialized it will be `None`

`can_pipeline`

Whether this session supports pipelining

class `SessionListener` ()

Base class for `Session` listeners, which are notified when a new NETCONF message is received or an error occurs.

Note: Avoid time-intensive tasks in a callback's context.

`callback` (*root*, *raw*)

Called when a new XML document is received. The `root` argument allows the callback to determine whether it wants to further process the document.

Parameters

- `root` (`tuple`) – tuple of (`tag`, `attributes`) where `tag` is the qualified name of the root element and `attributes` is a dictionary of its attributes (also qualified names)

- `raw` (`string`) – XML document

`errback` (*ex*)

Called when an error occurs.

2.4.2 SSH session implementation

static `default_unknown_host_cb` (*host*, *key*)

An unknown host callback returns `True` if it finds the key acceptable, and `False` if not.

This default callback always returns `False`, which would lead to `connect()` raising a `SSHUnknownHost` exception.

Supply another valid callback if you need to verify the host key programatically.

- Parameters**
- `host` (string) – the host for whom key needs to be verified
 - `key` (string) – a hex string representing the host key fingerprint

class `SSHSession` (*capabilities*)

Bases: `ncclient.transport.session.Session`

Implements a **RFC 4742** NETCONF session over SSH.

connect (*host*, [*port=830*, *timeout=None*, *username=None*, *password=None*, *key_filename=None*, *allow_agent=True*, *look_for_keys=True*])

Connect via SSH and initialize the NETCONF session. First attempts the publickey authentication method and then password authentication.

To disable attempting publickey authentication altogether, call with *allow_agent* and *look_for_keys* as `False`. This may be needed for Cisco devices which immediately disconnect on an incorrect authentication attempt.

- Parameters**
- `host` (string) – the hostname or IP address to connect to
 - `port` (int) – by default 830, but some devices use the default SSH port of 22 so this may need to be specified
 - `timeout` (int) – an optional timeout for the TCP handshake
 - `unknown_host_cb` (see *signature*) – called when a host key is not recognized
 - `username` (string) – the username to use for SSH authentication
 - `password` (string) – the password used if using password authentication, or the passphrase to use for unlocking keys that require it
 - `key_filename` (string) – a filename where a the private key to be used can be found
 - `allow_agent` (bool) – enables querying SSH agent (if found) for keys
 - `look_for_keys` (bool) – enables looking in the usual locations for ssh keys (e.g. `~/.ssh/id_*`)

load_known_hosts (*filename=None*)

Load host keys from a `known_hosts`-style file. Can be called multiple times.

If *filename* is not specified, looks in the default locations i.e. `~/.ssh/known_hosts` and `~/ssh/known_hosts` for Windows.

transport

Underlying `paramiko.Transport` object. This makes it possible to call methods like `set_keepalive` on it.

2.4.3 Errors

exception `TransportError`

Bases: `ncclient.NCClientError`

exception `SessionCloseError`

Bases: `ncclient.transport.errors.TransportError`

exception `SSHError`

Bases: `ncclient.transport.errors.TransportError`

exception `AuthenticationError`

Bases: `ncclient.transport.errors.TransportError`

exception `SSHUnknownHostError`

Bases: `ncclient.transport.errors.SSHError`

2.5 operations module

2.5.1 Base types

class `RPC` (*session*, [*async=False*, *timeout=None*])

Base class for all operations.

Directly corresponds to `<rpc>` requests. Handles making the request, and taking delivery of the reply.

set_async (*async=True*)

Set asynchronous mode for this RPC.

set_timeout (*timeout*)

Set the timeout for synchronous waiting defining how long the RPC request will block on a reply before raising an error.

reply

`RPCReply` element if reply has been received or `None`

error

`Exception` type if an error occurred or `None`.

This attribute should be checked if the request was made asynchronously, so that it can be determined if `event` being set is because of a reply or error.

Note: This represents an error which prevented a reply from being received. An `<rpc-error>` does not fall in that category – see `RPCReply` for that.

event

`Event` that is set when reply has been received or error occurred.

async

Whether this RPC is asynchronous

timeout

Timeout for synchronous waiting

id

The *message-id* for this RPC

session

The `Session` object associated with this RPC

class `RPCReply` (*raw*)

Represents an `<rpc-reply>`. Only concerns itself with whether the operation was successful.

Note: If the reply has not yet been parsed there is an implicit, one-time parsing overhead to accessing the attributes defined by this class and any subclasses.

ok

Boolean value indicating if there were no errors.

error

Short for `errors` [0]; `None` if there were no errors.

errors

`list` of `RPCError` objects. Will be empty if there were no `<rpc-error>` elements in reply.

class `RPCError` (*err_dict*)

Bases: `ncclient.operations.errors.OperationError`

Represents an `<rpc-error>`. It is an instance of `OperationError` and can be raised like any other exception.

type

`string` representing text of *error-type* element

severity

`string` representing text of *error-severity* element

tag

`string` representing text of *error-tag* element

path
 string or None; representing text of *error-path* element

message
 string or None; representing text of *error-message* element

info
 string (XML) or None, representing *error-info* element

2.5.2 NETCONF Operations

Dependencies

Operations may have a hard dependency on some capability, or the dependency may arise at request-time due to an optional argument. In any case, a `MissingCapabilityError` is raised if the server does not support the relevant capability.

Return type

The return type for the `request()` method depends of an operation on whether it is synchronous or asynchronous (see base class `RPC`).

- For synchronous requests, it will block waiting for the reply, and once it has been received an `RPCReply` object is returned. If an error occurred while waiting for the reply, it will be raised.
- For asynchronous requests, it will immediately return an `Event` object. This event is set when a reply is received, or an error occurs that prevents a reply from being received. The `reply` and `error` attributes can then be accessed to determine which of the two it was :-)

General notes on parameters

Source / target parameters

Where an operation takes a source or target parameter, it is mainly the case that it can be a datastore name or a URL. The latter, of course, depends on the `:url` capability and whether the capability supports the specific schema of the URL. Either must be specified as a `string`.

If the source may be a `<config>` element, e.g. for `Validate`, specify in *DictTree XML representation* with the root element as `<config>`.

Filter parameters

Filter parameters, where applicable, can take one of the following types:

- A **tuple** of (*type*, *criteria*). Here *type* has to be one of “xpath” or “subtree”. For type “xpath”, the *criteria* should be a `string` that is a valid XPath expression. For type “subtree”, *criteria* should be in *DictTree XML representation* representing a valid subtree filter.
- A valid `<filter>` element in *DictTree XML representation*.

Retrieval operations

The reply object for these operations will be a `GetReply` instance.

class Get (*session*, *async=False*, *timeout=None*)
 Bases: `ncclient.operations.rpc.RPC`
 The `<get>` RPC

request (*filter=None*)

Parameter *filter* – optional; see *Filter parameters*

Seealso *Return type*

class GetConfig (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

The `<get-config>` RPC

request (*source, filter=None*)

Parameters • *source* – See *Source / target parameters*

• *filter* – optional; see *Filter parameters*

Seealso *Return type*

class GetReply (*raw*)

Bases: `ncclient.operations.rpc.RPCReply`

Adds attributes for the `<data>` element to `RPCReply`, which pertains to the `Get` and `GetConfig` operations.

data

Same as `data_ele`

data_xml

`<data>` element as an XML string

data_dtree

`<data>` element in *DictTree XML representation*

data_ele

`<data>` element as an `Element`

Locking operations

class Lock (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

`<lock>` RPC

request (*target*)

Parameter *target* (string) – see *Source / target parameters*

Return type *Return type*

class Unlock (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

`<unlock>` RPC

request (*target*)

Parameter *target* (string) – see *Source / target parameters*

Return type *Return type*

Configuration operations

class EditConfig (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

`<edit-config>` RPC

request (*target, config, default_operation=None, test_option=None, error_option=None*)

Parameters • *target* (string) – see *Source / target parameters*

• *config* (string or dict or `Element`) – a config element in *DictTree XML representation*

• *default_operation* (string) – optional; one of {'merge', 'replace', 'none'}

- *error_option* (string) – optional; one of {'stop-on-error', 'continue-on-error', 'rollback-on-error'}. Last option depends on the *:rollback-on-error* capability
- *test_option* (string) – optional; one of {'test-then-set', 'set'}. Depends on *:validate* capability.

Seealso *Return type*

class CopyConfig (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

<copy-config> RPC

request (*source, target*)

Parameters • *source* (string or dict or Element) – See *Source / target parameters*

- *target* (string or dict or Element) – See *Source / target parameters*

Seealso *Return type*

class DeleteConfig (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

<delete-config> RPC

request (*target*)

Parameter *target* (string or dict or Element) – See *Source / target parameters*

Seealso *Return type*

class Validate (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

<validate> RPC. Depends on the *:validate* capability.

request (*source*)

Parameter *source* (string or dict or Element) – See *Source / target parameters*

Seealso *Return type*

class Commit (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

<commit> RPC. Depends on the *:candidate* capability.

request (*confirmed=False, timeout=None*)

Requires *:confirmed-commit* capability if *confirmed* argument is `True`.

Parameters • *confirmed* (bool) – optional; request a confirmed commit

- *timeout* (int) – specify timeout for confirmed commit

Seealso *Return type*

class DiscardChanges (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

<discard-changes> RPC. Depends on the *:candidate* capability.

request ()

Seealso *Return type*

Session management operations

class CloseSession (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

<close-session> RPC. The connection to NETCONF server is also closed.

request ()

Seealso *Return type*

class KillSession (*session, async=False, timeout=None*)

Bases: `ncclient.operations.rpc.RPC`

<kill-session> RPC.

request (*session_id*)

Parameter *session_id* (`string`) – *session-id* of NETCONF session to kill

Seealso *Return type*

Also useful

class LockContext (*session, target*)

A context manager for the `Lock / Unlock` pair of RPC's.

Initialise with session instance (`Session`) and lock target (*Source / target parameters*)

2.5.3 Errors

exception OperationError

Bases: `ncclient.NCClientError`

exception TimeoutExpiredError

Bases: `ncclient.NCClientError`

exception MissingCapabilityError

Bases: `ncclient.NCClientError`

EXTENDING NCCLIENT

This is written in a 'how-to' style through code examples.

Forthcoming

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