gRPC Agent

This chapter contains the following topics:

About the gRPC Agent

The Cisco NX-OS gRPC protocol defines a mechanism through which a network device can be managed and its configuration data can be retrieved and installed. The protocol exposes a complete and formal Application Programming Interface (API) that clients can use to manage device configurations.

The Cisco NX-OS gRPC protocol uses a remote procedure call (RPC) paradigm where an external client manipulates device configurations utilizing Google Protocol Buffer (GPB)-defined API calls along with their service- specific arguments. These GPB-defined APIs transparently cause an RPC call to the device that return replies in the same GPB-defined API context.

The gRPC Agent provides a secure transport through TLS and user authentication and authorization through AAA.

The functional objective of the Cisco NX-OS gRPC protocol is to mirror that provided by NETCONF, particularly in terms of both stateless and stateful configuration manipulation for maximum operational flexibility.

The Cisco NX-OS gRPC Agent supports the following protocol operations:

- Get
- GetConfig
- GetOper
- EditConfig
- StartSession
- CloseSession

- KillSession

The gRPC Agent supports two types of operations:

- **Stateless operations** are performed entirely within a single message without creating a session.
- **Stateful operations** are performed using multiple messages. The following is the sequence of operations that are performed:
  1. Start the session. This action acquires a unique session ID.
  2. Perform session tasks using the session ID.
  3. Close the session. This action invalidates the session ID.

The following are the supported operations. See the Appendix for their RPC definitions in the .proto file that is exported by the gRPC Agent.

Operation	Description
StartSession	Starts a new session between the client and server and acquires a unique session ID.
EditConfig	Writes the specified YANG data subset to the target datastore.
GetConfig	Retrieves the specified YANG configuration data subset from the source datastore.
GetOper	Retrieves the specified YANG operational data from the source datastore.
Get	Retrieves the specified YANG configuration and operational data from the source datastore.
KillSession	Forces the termination of a session.
CloseSession	Requests graceful termination of a session.

GetConfig, GetOper, and Get are stateless operations so don’t require a session ID.

EditConfig can be either stateless or stateful. For a stateless operation, specify the SessionID as 0. For a stateful operation, a valid (nonzero) SessionID is required.

The gRPC Agent supports timeout for the sessions. The idle timeout for sessions can be configured on the device, after which idle sessions are closed and deleted.

Guidelines and Limitations

The gRPC Agent has the following guideline and limitation:

- gRPC does not support enhanced Role-Based Access Control (RBAC) as specified in RFC 6536. Only users with a "network-admin" role are granted access to the gRPC agent.

Configuring the gRPC Agent

The gRPC Agent supports the following configuration parameters under the `[grpc]` section of the configuration file (`/opt/mtx/etc/grpc.key`).

Parameter	Description
idle_timeout	(Optional) Specifies the timeout in minutes after which idle client sessions are disconnected. The default timeout is 5 minutes. A value of 0 disables timeout.
limit	(Optional) Specifies the number of maximum simultaneous client sessions. The default limit is 5 sessions. The range is from 1 through 50.
lport	(Optional) Specifies the port number on which the gRPC Agent listens. The default port is 50051.
key	Specifies the key file location for TLS authentication. The default location is `/opt/mtx/etc/grpc.key`
cert	Specifies the certificate file location for TLS authentication. The default location is `/opt/mtx/etc/grpc.key`
security	Specifies the type of secure connection. Valid choices are: • **TLS** for TLS • **NONE** for an unsecure connection

The following is an example of the `[grpc]` section in the configuration file:

```
[grpc]
mtxadapter=/opt/mtx/lib/libmtxadaptergrpc.1.0.1.so
idle_timeout=10
limit=1
lport=50051
security=TLS
cert=/etc/grpc.pem
key=/etc/grpc.pem
```

For the modified configuration file to take effect, you must restart the gRPC Agent using the CLI command [**no**] **feature grpc** to disable and reenable.

Using the gRPC Agent

General Commands

You can enable or disable the gRPC Agent by issuing the [**no**] **feature grpc** command.

Example: A Basic Yang Path in JSON Format

```
client-host % cat payload.json
{
  "namespace": "http://cisco.com/ns/yang/cisco-nx-os-device",
  "System": {
    "bgp-items": {
      "inst-items": {
        "dom-items": {
          "Dom-list": {
            "name": "default",
            "rtrId": "7.7.7.7",
            "holdIntvl": "100"
          }
        }
      }
    }
  }
}
```

Note The JSON structure has been pretty-formatted here for readability.

Sending an EditConfig Request to the Server

```
client-host % ./grpc_client -username=admin -password=cisco -operation=EditConfig
-e_oper=Merge -def_op=Merge -err_op=stop-on-error -infile=payload.json -reqid=1
-source=running -tls=true -serverAdd=192.0.20.123 -lport=50051

######################################################
Starting the client service
######################################################
TLS set true for client requests1ems.cisco.com
TLS FLAG:1
192.0.20.123:50051
All the client connections are secured
Sending EditConfig request to the server
sessionid is
0
reqid:1
{"rpc-reply":{"ok":""}}
```

Sending a GetConfig Request to the Server

```
client-host % ./grpc_client -username=admin -password=cisco -operation=GetConfig
-infile=payload.json -reqid=1 -source=running -tls=true -serverAdd=192.0.20.123 -lport=50051
```

```
##################################################
Starting the client service
##################################################
TLS set true for client requests1ems.cisco.com
TLS FLAG:1
192.0.20.123:50051
All the client connections are secured
Sending GetConfig request to the server
in get config
Got the response from the server
########################################
Yang Json is:
########################################
{"rpc-reply":{"data":{"System":{"bgp-items":{"inst-items":{"dom-items":{"Dom-list":{"name":"default","rtrId":"7.7.7.7","holdIntvl":"100"}}}}}}}}
########################################
client-host %
```

Troubleshooting the gRPC Agent

Troubleshooting Connectivity

- From a client system, verify that the agent is listening on the port. For example:

```
client-host % nc -z 192.0.20.222 50051
Connection to 192.0.20.222 50051 port [tcp/*] succeeded!
client-host % echo $?
0
client-host %
```

- In the Bash shell of the switch, execute the **service grpc status** command to check the agent status.

gRPC Protobuf File

The gRPC Agent exports the supported operations and data structures in the proto definition file at `/opt/mtx/etc/nxos_grpc.proto`. The file is included in the gRPC Agent RPM. The following shows the definitions:

```
// Copyright 2016, Cisco Systems Inc.
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syntax = "proto3";

package NXOSExtensibleManagabilityService;

// Service provided by Cisco NX-OS gRPC Agent
service gRPCConfigOper {

    // Retrieves the specified YANG configuration data subset from the
    // source datastore
    rpc GetConfig(GetConfigArgs) returns(stream GetConfigReply) {};

    // Retrieves the specified YANG operational data from the source datastore
```

```
    rpc GetOper(GetOperArgs) returns(stream GetOperReply) {};

    // Retrieves the specified YANG configuration and operational data
    // subset from the source datastore
    rpc Get(GetArgs) returns(stream GetReply){};

    // Writes the specified YANG data subset to the target datastore
    rpc EditConfig(EditConfigArgs) returns(EditConfigReply) {};

    // Starts a new session between the client and server and acquires a
    // unique session ID
    rpc StartSession(SessionArgs) returns(SessionReply) {};

    // Requests graceful termination of a session
    rpc CloseSession(CloseSessionArgs) returns (CloseSessionReply) {};

    // Forces the termination of a session
    rpc KillSession(KillArgs) returns(KillReply) {};

// Unsupported; reserved for future
    rpc DeleteConfig(DeleteConfigArgs) returns(DeleteConfigReply) {};

    // Unsupported; reserved for future
    rpc CopyConfig(CopyConfigArgs) returns(CopyConfigReply) {};

    // Unsupported; reserved for future
    rpc Lock(LockArgs) returns(LockReply) {};

    // Unsupported; reserved for future
    rpc UnLock(UnLockArgs) returns(UnLockReply) {};

    // Unsupported; reserved for future
    rpc Commit(CommitArgs) returns(CommitReply) {};

    // Unsupported; reserved for future
    rpc Validate(ValidateArgs) returns(ValidateReply) {};

    // Unsupported; reserved for future
    rpc Abort(AbortArgs) returns(AbortReply) {};

}

message GetConfigArgs
{
    // JSON-encoded YANG data to be retrieved
    string YangPath = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;

    // (Optional) Specifies the source datastore; only "running" is supported.
    // Default is "running".
    string Source = 3;
}

message GetConfigReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // JSON-encoded YANG data that was retrieved
    string YangData = 2;

    // JSON-encoded error information when request fails
```

```
    string Errors = 3;
}

message GetOperArgs
{
    // JSON-encoded YANG data to be retrieved
    string YangPath = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;
}

message GetOperReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // JSON-encoded YANG data that was retrieved
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message GetArgs
{
    // JSON-encoded YANG data to be retrieved
    string YangPath=1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;
}

message GetReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // JSON-encoded YANG data that was retrieved
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message EditConfigArgs
{
    // JSON-encoded YANG data to be edited
    string YangPath = 1;

    // Specifies the operation to perform on teh configuration datastore with
    // the YangPath data.  Possible values are:
    //   create
    //   merge
    //   replace
    //   delete
    //   remove
    // If not specified, default value is "merge".
    string Operation = 2;

    // A unique session ID acquired from a call to StartSession().
    // For stateless operation, this value should be set to 0.
    int64 SessionID = 3;
```

```
    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 4;

    // (Optional) Specifies the target datastore; only "running" is supported.
    // Default is "running".
    string Target = 5;

    // Specifies the default operation on the given object while traversing
    // the configuration tree.
    // The following operations are possible:
    //   merge:     merges the configuration data with the target datastore;
    //              this is the default.
    //   replace:   replaces the configuration data with the target datastore.
    //   none:      target datastore is unaffected during the traversal until
    //              the specified object is reached.
    string DefOp = 6;

    // Specifies the action to be performed in the event of an error during
    // configuration.  Possible values are:
    //   stop
    //   roll-back
    //   continue
    // Default is "roll-back".
    string ErrorOp = 7;
}

message EditConfigReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If EditConfig is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message DeleteConfigArgs
{
    // A unique session ID acquired from a call to StartSession().
    // For stateless operation, this value should be set to 0.
    int64 SessionID = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;

    // (Optional) Specifies the target datastore; only "running" is supported.
    // Default is "running".
    string Target = 3;
}

message DeleteConfigReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If DeleteConfig is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}
```

```
message CopyConfigArgs
{
    // A unique session ID acquired from a call to StartSession().
    // For stateless operation, this value should be set to 0.
    int64 SessionID = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;

    // (Optional) Specifies the source datastore; only "running" is supported.
    // Default is "running".
    string Source = 3;

    // (Optional) Specifies the target datastore; only "running" is supported.
    // Default is "running".
    string Target = 4;
}

message CopyConfigReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If CopyConfig is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message LockArgs
{
    // A unique session ID acquired from a call to StartSession().
    int64 SessionID = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID=2;

    // (Optional) Specifies the target datastore; only "running" is supported.
    // Default is "running".
    string Target = 3;
}

message LockReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If Lock is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message UnLockArgs
{
    // A unique session ID acquired from a call to StartSession().
    int64 SessionID = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;

    // (Optional) Specifies the target datastore; only "running" is supported.
```

```
    // Default is "running".
    string Target = 3;
}

message UnLockReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If UnLock is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message SessionArgs
{
    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 1;
}

message SessionReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;
    int64 SessionID = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message CloseSessionArgs
{
    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 1;

    // A unique session ID acquired from a call to StartSession().
    int64 SessionID = 2;
}

message CloseSessionReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If CloseSession is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message KillArgs
{
    // A unique session ID acquired from a call to StartSession().
    int64 SessionID = 1;

    int64 SessionIDToKill = 2;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 3;
}
```

```
message KillReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If Kill is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message ValidateArgs
{
    // A unique session ID acquired from a call to StartSession().
    int64 SessionID = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;
}

message ValidateReply
{
    // The request ID specified in the request.
    int64 ReqID = 1;

    // If Validate is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message CommitArgs
{
    // A unique session ID acquired from a call to StartSession().
    int64 SessionID = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;
}

message CommitReply
{
    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 1;

    // If Commit is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}

message AbortArgs
{
    // A unique session ID acquired from a call to StartSession().
    int64 SessionID = 1;

    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 2;
}

message AbortReply
```

```
{
    // (Optional) Specifies the request ID.  Default value is 0.
    int64 ReqID = 1;

    // If Abort is successful, YangData contains a JSON-encoded "ok" response.
    string YangData = 2;

    // JSON-encoded error information when request fails
    string Errors = 3;
}
```