



API References

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1. RBFS API User Guide

1.1. RBFS REST APIs

This document contains all the information about RBFS REST API services, their purposes and how to use these APIs. This documentation goes hand-in-hand with the [RBFS OpenAPI document](#) which provides information about all RBFS REST API endpoints. It is recommended to refer to this document in conjunction with the RBFS OpenAPI document.

Introduction to RBFS REST APIs

RBFS REST APIs allow customers and partners to programmatically access information from the RBFS software components. RBFS REST APIs enable users to manage and automate many of their tasks by accessing and consuming the RBFS data simply and securely.

RBFS REST API architecture supports containerized deployments with a centralized configuration and management. It also enables the configuration and management of distinct daemons and services.

RBFS APIs adhere to the Representational State Transfer (REST) principles and allow consumers to securely connect to the RBFS device, obtain information (read) and run actions or operations to apply changes. RBFS REST APIs use JavaScript Object Notation (JSON) for the exchange of information. The OpenAPI Specification format, which is a broadly accepted industry standard for describing REST APIs, is used to describe, consume, and visualize RBFS REST APIs.

Understanding RBFS APIs

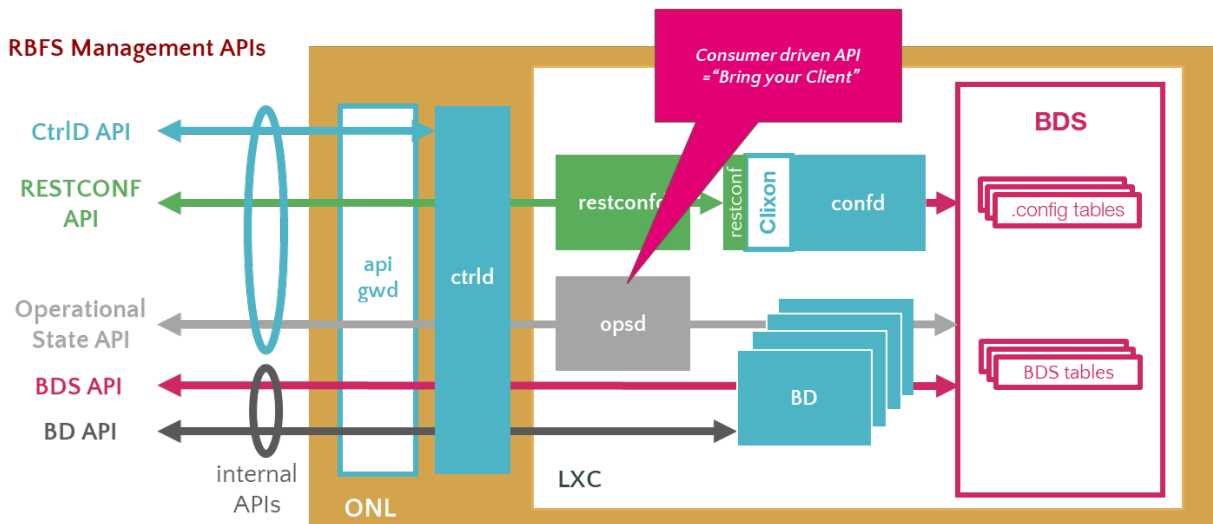
RBFS, a disaggregated Broadband Network Gateway, provides many APIs to make all communications possible with various RBFS software components, the host operating system (ONL), and the hardware platform. RBFS consists of several independent microservices including the API Gateway daemon ([ApiGwD](#)) and Control daemon ([CtrlD](#)). Both of these microservices, known as daemons, play crucial roles in managing RBFS instances.

API gateway functions only if management plane security is enabled. All API requests from external clients are routed to the API Gateway. After successful

authentication by the API Gateway, these requests are forwarded to the Control daemon. CtrlID, which is aware of the state and port information of all daemons that reside in the RBFS container, can forward requests to the respective daemons.



If security is disabled, API Gateway does not function and, then CtrlID becomes the first entry point for external requests.



The illustration presents how the RBFS REST APIs communication happens with various underlying software components. RBFS microservices, which perform various functions, are containerized in an open Linux container. RBFS APIs are generally categorized into Public Management APIs and Internal APIs. Public Management APIs include CtrlID API, RESTCONF API, and Operational state API. These APIs are used for managing and automating many of the network administration tasks.



The use of internal APIs such Brick Daemon APIs and BDS APIs are not supported.

The illustration also presents the API Gateway daemon (ApiGwD) and Control daemon (CtrlID), which are deployed on the host operating system (open network Linux) along with the RBFS container. The API Gateway acts as an entry point that provides a secure channel for all REST APIs by authenticating all requests. After successful authentication by the API Gateway, CtrlID (Control Daemon) passes all the requests to the respective daemons (that reside in the RBFS container) which are responsible for performing certain tasks.

RBFS APIs

CtrlID API: CtrlID runs on the host OS (ONL) and acts as a proxy to the other APIs including high-level APIs for the RBFS configurations. The CtrlID API, implemented by the CtrlID, performs various tasks such as starting the container and rebooting the device. In case of a software upgrade, this API is used to trigger the upgrade.

API Gateway: You can deploy the API Gateway Daemon (**ApiGwD**) on the host OS (that is ONL) to secure the RBFS management plane. The API Gateway authenticates all API requests using JSON web tokens. The API Gateway Daemon acts as the TLS endpoint for the hardware platform and it converts external access token into an internal RtBrick token **/SEC/**. Finally, it forwards the requests to the **CtrlID**.

The API Gateway also enforces an API throttler that provides a mechanism called API throttle quotas to protect the RBFS system resources from being exhausted with too many requests by a single client system that uses the RBFS APIs very extensively.

Operational State APIs: The Operational State API, provided by the Operational State Daemon (**opsd**), allows accessing system states such as routing protocol states, interface states, subscriber states and resource utilization. The Operational State Daemon takes care of examining the operational state of a switch and runs actions to diagnose and troubleshoot the problems. The operational state is ephemeral and state data is lost when the switch reboots.

RESTCONF APIs: With RESTCONF, you can manage all the configurations in RBFS.

Prometheus APIs: Prometheus APIs help to retrieve metrics from various RBFS components for visibility.



RFC and draft compliance mentioned in the document are partial except as specified.

1.2. Functions and Use cases of RBFS REST APIs

CtrlID API

The CtrlID performs various functions in the lifecycle of an RBFS container. Zero-Touch Provisioning installs the RBFS software on the hardware devices with

minimal human intervention. It is the responsibility of the CtrlID to initiate, discover and download the startup configuration files as part of zero-touch provisioning (ZTP) process. The CtrlID retrieves the base URL and executes the startup configuration on the device, that is pre-installed with ONL, the host operating system.

CtrlID API acts as a proxy endpoint that defines the way the API proxy interacts with the backend services. CtrlID is a go-between, which sits in the middle, for requests from clients and the API. As the API proxy, CtrlID, resides in front of the API, enforcing policies that dictate the usage of the API.

CtrlID API can be used to reboot the switch with or without a software upgrade. As a proxy endpoint, users can access the following APIs through CtrlID:

- RESTCONF API
- Operational State API
- Prometheus API

For more information about CtrlID API use case and examples, see section 5.1. *CtrlID API: Use Case and Example*'.

To view the CtrlID API Reference, navigate to [RBFS APIs](#), and select [CTRLD API Reference](#) from the drop-down list.

RESTCONF API

RESTCONF is an HTTP-based REST API protocol for network management and automation. It provides a programmatic interface for accessing data defined in YANG. The YANG model describes the configuration syntax. In RBFS, the RESTCONF API provides the configuration data.

Users can use RESTCONF API to execute various configurations in RBFS. RESTCONF API can be used for the following tasks:

- Read configurations
- Replace configurations
- Partial configuration update
- Remove configurations

For more information about RESTCONF API use case and examples, see section *5.2. RESTCONF API: Use Case and Example*.

To view the RESTCONF API Reference, navigate to [RBFS APIs](#), and select [RESTCONF API Reference](#) from the drop-down list.

Operational State API

The Operational State API ([opsd](#)) provides the system state information. The [opsp](#) is backward compatible and supports running older and newer versions of applications together in the network. The Backward compatibility feature is useful whenever newer RBFS releases are rolled out.

The Operational State API was implemented using the Python language that provides a collaborative system to all stakeholders including integration partners, customers, professional services and engineering to collaborate on the API endpoints.

To view the Operational State API Reference, navigate to [RBFS APIs](#), and select [Operational State API Reference](#) from the drop-down list.

For more information about Operational State API use case and examples, see section *5.3. Operational State API: Use Case and Example*.

Guidelines and Limitations

When you execute configurations through management APIs, and then with the Command Line Interface at the same time, it results in conflicts when you commit the configuration through the CLI. The reason is that CtrlID directly interacts with the backend applications and these changes are not synced with the CLI.

1.3. Configure API Gateway and CtrlID Components

The section provides configuration information for various components of the API Gateway and CtrlID. Both the API Gateway and CtrlID have been installed as part of the RBFS installation on the host operating system. You must complete some additional configurations for running API Gateway and CtrlID.

Configure API Gateway Components

The API Gateway service is called `rtbrick-apigwd` and the API Gateway daemon contains some default parameters.

- To know the installed API gateway version, run the `apigwd -version` command.
- To display the default settings and the location of configuration files, run the `apigwd -help` command.

The mandatory API Gateway configuration files include:

- API Gateway configuration file: `/etc/rtbrick/apigwd/config.json`
- JWKS file for access token verification: `/etc/rtbrick/apigwd/access_secret_jwks.json`
- X509 public/private key file in the 'pem' format: `/etc/rtbrick/apigwd/tls.pem`

SSL/TLS Certificate

API Gateway uses Transport Layer Security (TLS), also known as Secure Sockets Layer (SSL), certificates to authenticate and secure all requests pass through API Gateway.

If there is no TLS certificate provided, API Gateway generates one certificate signed by a self-signed root CA.

You can specify a TLS certificate in any of the following ways:

- Deploy the TLS file through ZTP
- Provide the URL for TLS file downloading in the `config.json` file.

With this setting, API Gateway monitors the server periodically for new TLS files using the HTTP caching directives as described in the [RFC 7234](#) to avoid unnecessary downloads.

tls.pem file

The `tls.pem` file, which contains the X509 certificate (public and private key), enables TLS in PEM format (as described in the [RFC 7468](#)). The `tls.pem` file can be changed on the file system. API Gateway automatically reloads the `tls.pem` file whenever it gets changed or replaced.

/etc/rtbrick/apigwd/tls.pem example

```
-----BEGIN CERTIFICATE-----  
NOT A REAL KEY  
-----END CERTIFICATE-----  
-----BEGIN RSA PRIVATE KEY-----  
NOT A REAL KEY  
-----END RSA PRIVATE KEY-----
```

JSON Web Token File

JSON Web Token ([RFC 7517](#)) enables secure transmission of information between client and server as a JSON object. API Gateway validates the access token against a JSON Web Key Set (JWKS) and it allows specifying two sources for the keyset. The sources are consulted in the following order for validation:

A local file on the file system

This file can be deployed through ZTP. It is recommended to deploy a local file on the file system. If it is an empty key set file, there is a default pre-configured file on the system that is used.

Remote file URLs through the config.json

You can provide the JWKS remote file URLs through the [config.json](#) file. Whenever a token needs to be verified, a JWKS file gets downloaded.

Whenever an access token needs to be verified, the API Gateway queries the server for the current JWKS file using the HTTP caching directives (as described in [RFC 7234](#)) to avoid unnecessary downloads.



An RFC 7234-compliant cache is used for downloading the configuration file.

JSON Web Key Set

The JSON Web Key Set contains the public keys used to verify any JSON Web Token issued by the authorization system.

The [access_secret_jwks.json](#) file can be updated on the file system.

API Gateway automatically reloads the [tls.pem](#) file whenever it gets changed or replaced.

/etc/rtbrick/apigwd/access_secret_jwks.json example

```
{
  "keys": [
    {
      "kty": "RSA",
      "e": "AQAB",
      "use": "sig",
      "kid": "access",
      "alg": "RS256",
      "n": "NOT A REAL KEY"
    }
  ]
}
```

These keys authenticate external requests coming to the API Gateway. The right key is selected by the **kid** (key id) attribute. With this key, the access tokens are verified and converted into an RtBrick token.

config.json File

The **config.json** is the configuration file of the API Gateway. API Gateway automatically reloads the file whenever it gets changed or replaced.

/etc/rtbrick/apigwd/config.json example

```
{
  "access_token_jwks_urls": [
    "http://192.168.202.56:8080/primaryJWKS",
    "http://192.168.202.56:8080/secondaryJWKS"
  ],

  "request_rate": 5,
  "request_burst": 10,
  "report_rejects_every": 10
}
```

The following table presents the various attributes and the description of the **config.json** file.

/etc/rtbrick/apigwd/config.json format

Name	Type	Description
access_token_jwks_urls	[]string	Allows to specify multiple JWKS remote URLs.
Remote PEM file		

pem_urls	[]string	Allows to specify multiple PEM remote URLs. Empty list disables the download.
pem_reload_time	int	Allows to specify the time after a new reload is triggered. 0 disables the download.
Request rate limit		
request_rate	float	The allowed requests per second per client.
request_burst	int	Is the maximum number of tokens that can be consumed at once, without respect to the rate.
report_rejects_ever	int	Report rejects only every x seconds to avoid massive logging to a GELF endpoint.

Control Daemon (CtrlD)

The CtrlD service is called `rtbrick-ctrld` and the CtrlD contains some default parameters.

- To know the installed CtrlD version, run the `ctrld -version` command.
- To display the default settings and the location of configuration files, run the `ctrld -help` command.

The CtrlD configuration files include:

- The CtrlD configuration file: `/etc/rtbrick/ctrld/config.json`
- The Role-Based Access Control policy file: `/etc/rtbrick/ctrld/policy.json`
- The element configuration file for the container: `/var/lib/lxc/<container-name>/element.config`

config.json file

The `config.json` file can be changed using API. If the file is updated on the file system, CtrlD must be restarted.



Changes to the `config.json` file will come into effect only after CtrlD gets restarted. Use the CtrlD API to apply in-service configuration changes at runtime. CtrlD updates the `config.json` file to get the changes applied through the API persistent.

/etc/rtrbrick/ctrlld/config.json example

```

{
  "element_name": "element_name",
  "pod_name": "pod_name",
  "rbms_enable": true,
  "rbms_host": "http://198.51.100.48",
  "rbms_authorization_header": "Bearer THIS IS NOT A REAL KEY",
  "rbms_heartbeat_interval": 10,
  "logging": {
    "heartbeat_interval": 60,
    "aliases": {
      "default": {
        "endpoints": [
          {
            "type": "gelf",
            "max_log_level": 5,
            "buffer_size": 500,
            "network": "http",
            "address": "http://10.200.32.49:12201/gelf"
          },
          {
            "type": "syslog",
            "max_log_level": 5,
            "buffer_size": 30,
            "network": "udp",
            "address": "10.200.32.49:516"
          }
        ]
      },
      "ztp": {
        "endpoints": [
          {
            "type": "gelf",
            "max_log_level": 4,
            "buffer_size": 20,
            "network": "http",
            "address": "http://10.200.32.49:12201/gelf"
          }
        ]
      }
    }
  },
  "auth_enabled": false
}
    
```

The following table presents the various attributes and descriptions for CtrlID `config.json` file.

/etc/rtrbrick/ctrlld/config.json format

Name	Type	Description
element_name	string	The name of the element (container).

pod_name	string	The pod name. Pod stands for point (zone) of deployment. A pod can contain a group of elements.
rbms_enable	bool	To enable all RBMS outgoing messages rbms_host.
rbms_host	string	RBMS base URL. For example, http://198.51.100.144:9009
rbms_authorization_header	string	RBMS Authorization Header is set to all calls which are outgoing to RBMS.
rbms_heartbeat_interval	int	RBMS heartbeat interval in seconds (0 means deactivated)
auth_enabled	bool	To enable the authorization and authentication.

logging

Log configuration for the host personality of the switch. The routing instances (elements) can configure the logging in the RBFS configuration, and that is forwarded, for the routing instance, to CtrlID. The alias (also known as external log server or Plugin Alias) **default** acts as the default alias if a specific alias is not defined.

Name	Type	Description
alias	string	Logical name of the endpoints. For example, ztp for ztp messages.

Each alias can have multiple endpoints. If an alias does not define any endpoint, the alias is disabled and the message is not sent and to the default alias.

Name	Type	Description
type	string	Type could be syslog or gelf .
max_log_level	string	MaxLogLevel that will be forwarded (default "Notice: 5")
network	string	Network get network either tcp, udp or http. Consider the support matrix: * gelf: http * syslog: udp, tcp
buffer_size	string	BufferSize that will be used for the fanout, if the buffer is full, the newer messages that arrive are thrown away.
address	string	Address where to send the message
formatter	string	The formatter that should be used. Consider the support matrix: <ul style="list-style-type: none"> • gelf: none • syslog: rfc5424

policy.json file

The policy.json file is used to configure role-based access control (RBAC) for CtrlID. This file can be changed using API. If it is changed on the file system, CtrlID must be restarted.

/etc/rtbrick/ctrlid/policy.json example

```
{
  "permissions": [
    {"sub": "system", "obj": "/*", "act": ".*" },
    {"sub": "supervisor", "obj": "/*", "act": ".*" },
    {"sub": "operator", "obj": "/*", "act": ".*"},
    {"sub": "reader", "obj": "/*", "act": "GET"},
    {"sub": "reader", "obj":
"/api/v1/rbfs/elements/{element_name}/services/{service_name}/proxy/bds/table/walk
", "act": ".*"},
    {"sub": "reader", "obj":
"/api/v1/rbfs/elements/{element_name}/services/{service_name}/proxy/bds/object/get
", "act": ".*"}
  ]
}
```

/etc/rtbrick/ctrlid/policy.json format

Name	Type	Description
sub	string	Subjects means the role which has the permission. Here RegexMatch Function is used: a regular expression pattern matcher.
obj	string	Object is the REST endpoint. Here KeyMatch4 Function is used: KeyMatch4 determines whether key1 matches the pattern of key2 (similar to RESTful path), key2 can contain a * and other patterns: <ul style="list-style-type: none"> "/foo/bar" matches "/foo/" "/resource1" matches "{resource}" "/parent/123/child/123" matches "/parent/{id}/child/{id}" "/parent/123/child/456" does not match "/parent/{id}/child/{id}"

Name	Type	Description
act	string	And Action is the HTTP Method. Here RegexMatch Function is used: a regular expression pattern matcher.

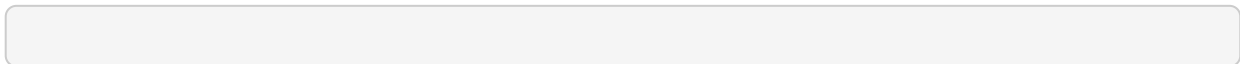
The rules are:

- The user with the role 'system' can access all the rest endpoints and act on them with all HTTP methods.
- The user with the role 'reader' can access all rest endpoints; but can only call the HTTP GET method.
- All authenticated users are allowed to access the proxy endpoint with all HTTP methods.

element.config file

The **element.config** file allows to rename the default element name. By default, the element name and the container name are the same. You can use the file to rename the default element name so that the element name and the container name are differentiated.

/var/lib/lxc/<container-name>/element.config example



/var/lib/lxc/<container-name>/element.config format

Name	Type	Description
element_name	string	Name of the element (By default, it is the container name).
pod_name	string	Name of the PoD.
ztp_enabled	bool	If enabled, the ZTP post process starts when the switch is moved to the operational state "up". It is recommended to set this to 'false'. In that case, only the initial installation or reinstallation triggers that process.

1.4. Events

RBFS REST APIs play important roles in fetching event logs. Event logs are records of events that occur in the different functional areas of the RBFS ecosystem. In RBFS, there are different types of logs. Almost every daemon or module in RBFS generates a variety of logs. All these logs, which are generated from different components, can be exported to the log management server, where you can view and analyze the real-time data.

Log events originate from the RBFS log facility and form a structured log record. If logging is disabled, then no logs are produced. For more information about RBFS Logging, see /resources/techdocs/current/loggingug/logging_intro.html [Logging User Guide].

Alerts

Alerts are event logs that originate from alert configurations. Alerts either report an issue or notify that an issue has been resolved. Alerts are fully under the control of a customer. Users can implement alert rules to produce an alert that triggers automated action in the management system. An alert event is also a business event when it triggers automated actions.

Business Events

A business event is a record of events that originate from the control daemon, irrespective of the logging configuration. Business events notify the management system about significant state changes for triggering automated actions.

Business events are recorded by CtrlID and these events are static without any changes release after release.

APIGwD and CtrlID send different GELF and Syslog messages about status changes or the progress of processes to a GELF or Syslog endpoint.

The following table presents the business event message format:

GELF message format

Name	Type	Mandatory	Description
Default Message Fields			

Name	Type	Mandatory	Description
version	String	Yes	The GELF message format version. Default value: 1.1
host	String	Yes	The hostname is assigned via DHCP to the management interface. Defaults to the management IP address if no hostname is assigned.
level	int	Yes	Message Severity. See Table-1.
timestamp	float	Yes	Unix epoch time in seconds with an optional fraction of milliseconds.
short_message	String	Yes	Problem message.
full_message	String	No	Detailed problem description.
_daemon	String	Yes	Name of the daemon.
_log_module	String	Yes	The module name identifies the component that created the log record. It allows segregating log records into different streams. Each stream can apply different processing rules and also be processed by different organizational units of the network operator.
_log_event	String	Yes	The log event identifies the log message template in the log configuration. The log event simplifies finding where in the system the log record was created. The log event should be succinct and typically conveys a unique reason code. In addition, the log event should be a reference that can be looked up in the product troubleshooting guide.

Name	Type	Mandatory	Description
_serial_number	String	Yes	The serial number of the switch. This allows tracking hardware replacements, even if the element name remains the same. Empty if not available.
_rtb_image_version	String	No	ONL Image Version that is installed on the switch that reports this message.
_origin	String	No	host or container , defines the origin of a message. This is only set for events that are ambiguous.
ZTP Message Fields			
_config_name	String	No	Exposes the loaded configuration name. Only set when a configuration file was processed or an attempt to process the file failed (e.g., 404 Not Found response from the HTTP server while attempting to load the configuration)
_config_sha1	String	No	Exposes the SHA1 checksum of the loaded configuration. Only set when the HTTP server returns a configuration.
_operational_state	String	No	Exposes the operational state of the element.
Request Message Fields			
_rid	String	No	Request ID, either X-Request-ID or new generated
_user_name	String	No	User name out of the access token
_user_subject	String	No	User subject out of the access token
_received_time	String	No	Time when the requested arrived
_method	String	No	HTTP method
_url	String	No	HTTP url

Name	Type	Mandatory	Description
proto	String	No	HTTP protocol
_remote_ip	String	No	HTTP remote ip address
Service State Message Fields			
_service_name	String	No	Service name
_service_operational_state	String	No	Operational Service
_service_startup_time	Number	No	Service startup time in unix epoch time, the number of seconds elapsed since January 1, 1970 UTC.
_service_down_flap_time	Number	No	Last down flap time in unix epoch time, the number of seconds elapsed since January 1, 1970 UTC.
_service_down_flap_counter	Number	No	Last down flap time in unix epoch time, the number of seconds elapsed since January 1, 1970 UTC.
_service_restarted	String	No	Restart is set to true if service_startup_time was changed.

Level Descriptions as in RFC 5424

Level	Name	Comment
0	Emergency	System is unusable
1	Alert	Action must be taken immediately
2	Critical	Critical conditions
3	Error	Error conditions
4	Warning	Warning conditions
5	Notice	Normal but significant condition
6	Informational	Informational messages
7	Debug	Debug-level messages

GELF sample message

```
{
  "_config_name": "ctrlld",
  "_config_sha1": "f1e06ef1e53becde6f8baf2b2fafa7dc9c36f6f0",
}
```

```

    "_daemon": "ctrld",
    "_element_name": "leaf01",
    "_log_event": "ZTP0011I",
    "_log_module": "ztp",
    "_serial_number": "591654XK1902037",
    "host": "leaf01",
    "level": 6,
    "short_message": "ztp ctrld config set",
    "timestamp": 1588382356.000511,
    "version": "1.1"
}
    
```

Event Types

Instance	severity	log_module	log_event	log_config	description
ztp	Notice	ztp	ZTP0011I	ctrld	ztp ctrld config set
ztp	Warn	ztp	ZTP0012W	ctrld	ztp ctrld config not provided
ztp	Alert	ztp	ZTP0013E	ctrld	ztp ctrld config not set
ztp	Notice	ztp	ZTP0021I	ctrld	ztp startup config set
ztp	Warn	ztp	ZTP0022W	ctrld	ztp startup config not provided
ztp	Alert	ztp	ZTP0023E	ctrld	ztp startup config not set
ztp	Notice	ztp	ZTP0041I	ctrld	ztp ctrld rbac config set
ztp	Warn	ztp	ZTP0042W	ctrld	ztp ctrld rbac config not provided
ztp	Alert	ztp	ZTP0043E	ctrld	ztp ctrld rbac config not set
ztp	Notice	ztp	ZTP0051I	ctrld	ztp tls config set
ztp	Warn	ztp	ZTP0052W	ctrld	ztp tls config not provided
ztp	Alert	ztp	ZTP0053E	ctrld	ztp tls config not set
ztp	Notice	ztp	ZTP0061I	ctrld	ztp accessjwks config set
ztp	Warn	ztp	ZTP0062W	ctrld	ztp accessjwks config not provided
ztp	Alert	ztp	ZTP0063E	ctrld	ztp accessjwks config not set
ztp	Notice	ztp	ZTP0071I	ctrld	ztp apigwd config set
ztp	Warn	ztp	ZTP0072W	ctrld	ztp apigwd config not provided
ztp	Alert	ztp	ZTP0073E	ctrld	ztp apigwd config not set
ztp	Notice	ztp	ZTP1000I	ctrld	ztp process finished

security	Warn	security	SEC0001W	ctrlld	access forbidden
security	Warn	security	SEC0002W	ctrlld	access invalid rtb token
security	Warn	security	SEC0003W	ctrlld	access invalid access token
security	Warn	security	SEC0004W	ctrlld	not able to download remote keys
security	Warn	security	SEC0005W	ctrlld	not able to download remote pem
security	Warn	security	SEC0006W	ctrlld	request rate limited (this message is also rate limited, and can be controlled in the apiwd config)
element	Notice	element	HTB0001	ctrlld	heartbeat with the <code>operational_state</code>
element	Notice	element	STA0001	ctrlld	element state change
element	Notice	element	STA0021	ctrlld	service up
element	Error	element	STA0022	ctrlld	service unexpected down
element	Notice	element	STA0023	ctrlld	service expected down
element	Notice	element	STA0003	ctrlld	ready for service
element	Notice	element	STA0031	ctrlld	module new (one of the modules is newly discovered e.g. fan, SFP ..., this event will be fired after every reboot of ctrlld)
element	Notice	element	STA0032	ctrlld	module changed (one of the modules got changed e.g. fan, SFP ...)

element	Notice	element	STA0033	ctrlId	module removed (one of the modules got removed e.g. fan, SFP ...)
ALL	Notice	element	STA0040	all	messages could have been dropped
prometheus	?	?	?	element	messages generated by prometheus alerts

1.5. Appendix: Use case Scenario and Examples for RBFS REST APIs

CtrlID API: Use Cases and Examples

A single CtrlID instance can serve multiple RBFS containers. Each container forms a network element and has a unique name which is the 'element name'.

All API calls (requests) to an RBFS container contain the element name in the URL path.



BNG is used as the element name in the following examples.
NOTE: *10.0.0.1* is used as the management IP address in the following examples.

Rebooting a Switch

This example shows how to reboot the switch.

Rebooting a switch is an example of an *asynchronous* operation.

The API call returns the acknowledgment immediately that the reboot request has been *accepted* (HTTP Status Code 202).

The following list shows the HTTP request to reboot switch 10.0.0.1. The URL contains no element name because the entire switch will be rebooted.

```
POST /api/v1/ctrlId/system/_reboot HTTP/1.1
Host: 10.0.0.1:19091
```

Triggering a Software Upgrade

A software upgrade can be performed by executing the Zero-Touch Provisioning (ZTP) process again. The switch will be rebooted in Open Network Install Environment (ONIE) update mode and allow ONIE to discover the OS installer image and startup configuration files from the ZTP server.

Rebooting a switch is an example of *asynchronous* operation.

The API call returns a response immediately that the reboot request has been *accepted* (HTTP Status Code 202).

The following example shows the HTTP request to reboot switch 10.0.0.1. The URL contains no element name because the entire switch will be rebooted.

```
POST /api/v1/ctrlld/system/_update HTTP/1.1
Host: 10.0.0.1:19091
```

Using the Proxy Endpoint

The CtrlID proxy endpoint forwards API calls to the daemons hosting the API in the RBFS container. Three daemons host publicly available APIs:

- **opsd**, the operational state daemon, hosts the Operational State API.
- **restconfd**, the RESTCONF daemon, hosts the RESTCONF API.
- Prometheus hosts the Prometheus API.



All examples in the following sections use the CtrlID proxy endpoint.

The following table summarizes the proxy endpoint paths for the daemons: **opsd**, **restconfd**, and **Prometheus** and an element named **BNG**.

Daemon	Path
Operational State Daemon (opsd)	<code>/api/v1/rbfs/elements/cnbg-1/services/opsd/proxy</code>
RESTCONF Daemon (restconfd)	<code>/api/v1/rbfs/elements/cnbg-1/services/restconfd/proxy</code>

Daemon	Path
Prometheus	/api/v1/rbfs/elements/cnbg-1/services/prometheus/proxy

RESTCONF API: Use Cases and Examples

Reading the Current Configuration

The following request returns the complete switch configuration.

```
GET /api/v1/rbfs/elements/BNG/services/restconfd/proxy/restconf/data HTTP/1.1
Host: 10.0.0.1:19091
```

Reading the Time-series Settings

The [RESTCONF Protocol RFC](#) describes a comprehensive query syntax, which allows retrieving certain parts of the configuration.

The following API call retrieves all the time-series settings.

```
GET /api/v1/rbfs/elements/BNG/services/restconfd/proxy/restconf/data/rtbrick-config:time-series HTTP/1.1
Host: 10.0.0.1:19091
```

```
{
  "rtbrick-config:time-series": {
    "metric": [
      {
        "name": "subscriber_sessions",
        "table-name": "local.access.subscriber.count",
        "bds-type": "object-metric",
        "prometheus-type": "gauge",
        "description": "Established subscriber sessions",
        "attribute": [
          {
            "attribute-name": "ipoe_established",
            "label": [
              {
                "label-key": "access_type",
                "label-value": "ipoe",
                "label-type": "static"
              },
              {
                "label-key": "ifp_name",
                "label-value": "ifp_name",
                "label-type": "dynamic"
              }
            ]
          }
        ]
      }
    ]
  }
}
```

```

    ]
  }
]
},
{
  "name": "total_cpu_util_percent",
  "table-name": "global.chassis_0.resource.cpu_usage",
  "bds-type": "object-metric",
  "prometheus-type": "gauge",
  "description": "Total CPU utilization in percent",
  "attribute": [
    {
      "attribute-name": "total_cpu",
      "label": [
        {
          "label-key": "cpu",
          "label-value": "cpu_id",
          "label-type": "dynamic"
        }
      ]
    }
  ]
},
{
  "name": "total_memory_free_kilobyte",
  "table-name": "global.chassis_0.resource.mem_usage",
  "bds-type": "object-metric",
  "prometheus-type": "gauge",
  "description": "Total free RAM memory in kilo bytes",
  "attribute": [
    {
      "attribute-name": "free_mem",
      "label": [
        {
          "label-key": "memory",
          "label-value": "mem_id",
          "label-type": "dynamic"
        }
      ]
    }
  ]
},
{
  "name": "total_memory_used_kilobyte",
  "table-name": "global.chassis_0.resource.mem_usage",
  "bds-type": "object-metric",
  "prometheus-type": "gauge",
  "description": "Total used RAM memory in kilo bytes",
  "attribute": [
    {
      "attribute-name": "used_mem",
      "label": [
        {
          "label-key": "memory",
          "label-value": "mem_id",
          "label-type": "dynamic"
        }
      ]
    }
  ]
}
}

```

```

    ]
  }
}

```

RESTCONF also allows filtering for a specific time series.

```

GET /api/v1/rbfs/elements/BNG/services/restconfd/proxy/restconf/data/rtbrick-
config:time-series/metric=subscriber_sessions HTTP/1.1
Host: 10.0.0.1:19091

```

```

{
  "rtbrick-config:metric": [
    {
      "name": "subscriber_sessions",
      "table-name": "local.access.subscriber.count",
      "bds-type": "object-metric",
      "prometheus-type": "gauge",
      "description": "Established subscriber sessions",
      "attribute": [
        {
          "attribute-name": "ipoe_established",
          "label": [
            {
              "label-key": "access_type",
              "label-value": "ipoe",
              "label-type": "static"
            },
            {
              "label-key": "ifp_name",
              "label-value": "ifp_name",
              "label-type": "dynamic"
            }
          ]
        }
      ]
    }
  ]
}

```

In addition, RESTCONF allows querying the key values. The following API call selects the names of the configured time-series metrics.

```

GET /api/v1/rbfs/elements/BNG/services/restconfd/proxy/restconf/data/rtbrick-
config:time-series/metric=/name HTTP/1.1
Host: 10.0.0.1:19091

```

```

{
  "rtbrick-config:name": [
    "subscriber_sessions",
    "total_cpu_util_percent",
    "total_memory_free_kilobyte",
    "total_memory_used_kilobyte"
  ]
}

```

```
]
}
```

Adding a New Time-series

The RESTCONF API also allows replacing and adding new configurations to an existing configuration. The data is exchanged in JSON format.



The **Content-Type** header must be set to **application/yang-data+json**.

YANG is a modeling language that is used to describe the configurations. The RESTCONF Open API definition is generated from the YANG models and contains a reference to the respective YANG model.

The following API request adds a new **default_bgp_prefixes_count** time-series to the RBFs configuration.

```
PUT /api/v1/rbfs/elements/BNG/services/restconfd/proxy/restconf/data/rtbrick-
config:time-series/metric=default_bgp_prefixes_count HTTP/1.1
Host: 10.0.0.1:19091
Content-Type: application/yang-data+json
Content-Length: 4315
```

```
{
  "rtbrick-config:metric": [
    {
      "name": "default_bgp_prefixes_count",
      "table-name": "default.bgp.peer",
      "bds-type": "object-metric",
      "prometheus-type": "gauge",
      "description": "BGP peerings default instance",
      "attribute": [
        {
          "attribute-name": "ipv4_unicast_update_rcvd_cnt",
          "label": [
            {
              "label-key": "afi",
              "label-value": "ipv4",
              "label-type": "static"
            },
            {
              "label-key": "direction",
              "label-value": "in",
              "label-type": "static"
            },
            {
              "label-key": "peer",
              "label-value": "peer_ipv4_address",
              "label-type": "dynamic"
            }
          ]
        }
      ]
    }
  ]
}
```

```

        "label-key": "safi",
        "label-value": "unicast",
        "label-type": "static"
    }
]
},
{
    "attribute-name": "ipv4_unicast_update_sent_cnt",
    "label": [
        {
            "label-key": "afi",
            "label-value": "ipv4",
            "label-type": "static"
        },
        {
            "label-key": "direction",
            "label-value": "out",
            "label-type": "static"
        },
        {
            "label-key": "peer",
            "label-value": "peer_ipv4_address",
            "label-type": "dynamic"
        },
        {
            "label-key": "safi",
            "label-value": "unicast",
            "label-type": "static"
        }
    ]
},
{
    "attribute-name": "ipv6_unicast_update_rcvd_cnt",
    "label": [
        {
            "label-key": "afi",
            "label-value": "ipv6",
            "label-type": "static"
        },
        {
            "label-key": "direction",
            "label-value": "in",
            "label-type": "static"
        },
        {
            "label-key": "peer",
            "label-value": "peer_ipv4_address",
            "label-type": "dynamic"
        },
        {
            "label-key": "safi",
            "label-value": "unicast",
            "label-type": "static"
        }
    ]
},
{
    "attribute-name": "ipv6_unicast_update_sent_cnt",
    "label": [
        {
            "label-key": "afi",

```

```

        "label-value": "ipv6",
        "label-type": "static"
    },
    {
        "label-key": "direction",
        "label-value": "out",
        "label-type": "static"
    },
    {
        "label-key": "peer",
        "label-value": "peer_ipv4_address",
        "label-type": "dynamic"
    },
    {
        "label-key": "safi",
        "label-value": "unicast",
        "label-type": "static"
    }
]
}
]
}
]
}
}

```

The API returns a **201 Created** response if a new metric was added and returns **204 No Content** if an existing metric got updated.

Removing a Time-series

The following API request removes the **default_bgp_prefixes_count** time series from the switch configuration.

```

DELETE /api/v1/rbfs/elements/BNG/services/restconfd/proxy/restconf/data/rtbrick-
config:time-series/metric=default_bgp_prefixes_count HTTP/1.1
Host: 10.0.0.1:19091

```

The API returns a **204 No Content** response if the delete operation succeeded. Any API call to remove a configuration that does not exist results in a **409 Conflict** error response.

Example Response:

```

{
  "ietf-restconf:errors": {
    "error": {
      "error-type": "application",
      "error-tag": "data-missing",
      "error-severity": "error",
      "error-message": "Data does not exist; cannot delete resource"
    }
  }
}

```

```
}
}
```

Operational State API: Use Cases and Examples

The operational state API provides access to operational state data, including routing protocols, subscriber, and system state information. The operational state is a runtime information and will be reset after each reboot.



The operational state API is accessed through the CtrlD proxy endpoint.



Use Prometheus for operational state monitoring and metric sampling.

Querying Subscriber Sessions

The following example shows how to read up to five (limit=5) active subscriber sessions on port *ifp-0/0/0* (*ifp_name=ifp-0/0/0*).

```
GET /api/v1/rbfs/elements/BNG/services/opsd/proxy/subscribers?ifp_name=ifp-
0/0/0&limit=5 HTTP/1.1
Host: 10.0.0.1:19091
```

The API call uses the CtrlD proxy endpoint to invoke the Operational State API, the element name is *BNG* and the service name is *opsd*.

The following example shows five IPoE subscriber sessions.

```
[
  {
    "subscriber_id": 216454257090494480,
    "subscriber_id_str": "216454257090494480",
    "subscriber_state": "ESTABLISHED",
    "subscriber_user_name": "02:00:00:00:00:06@ipoe",
    "access_type": "IPoE",
    "accounting_session_id": "216454257090494480:1695654885",
    "ifp_name": "ifp-0/0/0",
    "outer_vlan": 128,
    "inner_vlan": 6,
    "client_mac": "02:00:00:00:00:06",
    "agent_remote_id": "DEU.RTBRICK.6",
    "agent_circuit_id": "0.0.0.0/0.0.0.0 eth 0:6"
  },
  {
    "subscriber_id": 216454257090494481,
    "subscriber_id_str": "216454257090494481",
```

```
"subscriber_state": "ESTABLISHED",
"subscriber_user_name": "02:00:00:00:00:07@ipoe",
"access_type": "IPoE",
"accounting_session_id": "216454257090494481:1695654885",
"ifp_name": "ifp-0/0/0",
"outer_vlan": 128,
"inner_vlan": 7,
"client_mac": "02:00:00:00:00:07",
"agent_remote_id": "DEU.RTBRICK.7",
"agent_circuit_id": "0.0.0.0/0.0.0.0 eth 0:7"
},
{
  "subscriber_id": 216454257090494482,
  "subscriber_id_str": "216454257090494482",
  "subscriber_state": "ESTABLISHED",
  "subscriber_user_name": "02:00:00:00:00:08@ipoe",
  "access_type": "IPoE",
  "accounting_session_id": "216454257090494482:1695654885",
  "ifp_name": "ifp-0/0/0",
  "outer_vlan": 128,
  "inner_vlan": 8,
  "client_mac": "02:00:00:00:00:08",
  "agent_remote_id": "DEU.RTBRICK.8",
  "agent_circuit_id": "0.0.0.0/0.0.0.0 eth 0:8"
},
{
  "subscriber_id": 216454257090494483,
  "subscriber_id_str": "216454257090494483",
  "subscriber_state": "ESTABLISHED",
  "subscriber_user_name": "02:00:00:00:00:09@ipoe",
  "access_type": "IPoE",
  "accounting_session_id": "216454257090494483:1695654885",
  "ifp_name": "ifp-0/0/0",
  "outer_vlan": 128,
  "inner_vlan": 9,
  "client_mac": "02:00:00:00:00:09",
  "agent_remote_id": "DEU.RTBRICK.9",
  "agent_circuit_id": "0.0.0.0/0.0.0.0 eth 0:9"
},
{
  "subscriber_id": 216454257090494484,
  "subscriber_id_str": "216454257090494484",
  "subscriber_state": "ESTABLISHED",
  "subscriber_user_name": "02:00:00:00:00:0a@ipoe",
  "access_type": "IPoE",
  "accounting_session_id": "216454257090494484:1695654885",
  "ifp_name": "ifp-0/0/0",
  "outer_vlan": 128,
  "inner_vlan": 10,
  "client_mac": "02:00:00:00:00:0a",
  "agent_remote_id": "DEU.RTBRICK.10",
  "agent_circuit_id": "0.0.0.0/0.0.0.0 eth 0:10"
}
]

```

Each subscriber session has a unique subscriber ID and the subscriber ID is an unsigned 64-bit integer.

The `subscriber_id` holds the numeric subscriber ID value, while `subscriber_id_str` contains a string representation of the subscriber ID.



Some tools and programming libraries comply **I-JSON standard**. This standard defines numeric values as double-precision floating-point numbers. As a result, subscriber ID values will be rounded and may confuse. It is recommended to read the subscriber ID from the `subscriber_id_str` in such environments.

Terminating a Subscriber Session

The following API call terminates the subscriber session for the subscriber with the subscriber ID: 216454257090494484.

```
DELETE
/api/v1/rbfs/elements/BNG/services/opsd/proxy/subscribers/216454257090494484
HTTP/1.1
Host: 10.0.0.1:19091
```

The switch returns a **202 Accepted** status code to acknowledge that the session is going to be terminated.

Prometheus: Use Cases and Examples

Accessing the Federation Endpoint

The Prometheus federation endpoint returns all metrics collected by Prometheus in the Prometheus Exposition Format.

```
GET
/api/v1/rbfs/elements/BNG/services/prometheus/proxy/federate?match%5B%5D=%7Bjob%3D%22bds%22%7D HTTP/1.1
Host: 10.0.0.1:19091
```



The `match` condition is required to select all BDS metrics that is metrics collected from brick daemons and the brick data store (BDS).

1.6. Related Documentation

/ONIE/	<p>The ONIE documentation outlines the DHCP options supported for image discovery.</p> <p>https://opencomputeproject.github.io/onie/design-spec/discovery.html</p>
/ZTP/	<p>The /resources/techdocs/current/tools/rbfs-ztp.html[Zero-Touch Provisioning Guide] outlines the current configuration discovery process.</p>
/SEC/	<p>The /resources/techdocs/current/secmgmt/secmgmt_intro.html[Securing the Management Plane Guide] Secure the Management Plane guide gives a detailed insight on this topic.</p>
/RADIUS/	<p>The /resources/techdocs/current/radiuservices/radiuservices_intro.html[RADIUS Services Guide] provides an overview of the supported RADIUS attributes including a reference to the RFC that defines the message attribute.</p>
/CTRLD/	<p>The CTRLD API reference describes all CTRLD REST API endpoints in detail. To view the CtrlID API Reference, navigate to RBFS APIs, and select CTRLD API Reference from the drop-down list.</p>
/RESTCONF/	<p>The RESTCONF API reference describes all configuration API endpoints. To view the RESTCONF API Reference, navigate to RBFS APIs, and select RESTCONF API Reference from the drop-down list.</p>
/GELF/	<p>The Graylog Extended Log Format (GELF) is a log format, this document outlines the fundamentals.</p> <p>To obtain this document, contact your customer support team.</p>

2. RBFS APIs

```

<link rel="stylesheet" type="text/css" href="._attachments/rtbrick.css">
<div id="swagger-ui"></div>
<script src="._attachments/swagger-ui-bundle.js"></script>
<script src="._attachments/swagger-ui-standalone-preset.js"></script>
<script>
window.onload = function () {
  const DisableTryItOutPlugin = function() {
    return {
      statePlugins: {
        spec: {
          wrapSelectors: {
            allowTryItOutFor: () => () => false
          }
        }
      }
    }
  }

  // Begin Swagger UI call region
  const ui = SwaggerUIBundle({
    urls: [
      { "url": "._attachments/rbfs/swagger_ctrlld.yaml", "name": "CTRLD API
Reference" },
      { "url": "._attachments/rbfs/rtbrick-config_restconf_swagger.json",
"name": "RESTCONF API Reference" },
      { "url": "._attachments/rbfs/swagger_opsd.yaml", "name": "Operational
State API Reference" },
      { "url": "._attachments/rbfs/swagger_bds.yaml", "name": "BDS API
Reference" },
    ],
    dom_id: '#swagger-ui',
    deepLinking: true,
    docExpansion: "none",
    presets: [
      SwaggerUIBundle.presets.apis,
      SwaggerUIStandalonePreset
    ],
    plugins: [
      SwaggerUIBundle.plugins.DownloadUrl,
      DisableTryItOutPlugin
    ],
    layout: "StandaloneLayout"
  })
  // End Swagger UI call region

  window.ui = ui
}
</script>

```

3. RBMS APIs

```
<link rel="stylesheet" type="text/css" href="._attachments/rtbrick.css">

<div id="swagger-ui"></div>

<script src="._attachments/swagger-ui-bundle.js"> </script>
<script src="._attachments/swagger-ui-standalone-preset.js"> </script>
<script>
  window.onload = function () {
    const DisableTryItOutPlugin = function() {
      return {
        statePlugins: {
          spec: {
            wrapSelectors: {
              allowTryItOutFor: () => () => false
            }
          }
        }
      }
    }

    // Begin Swagger UI call region
    const ui = SwaggerUIBundle({
      urls: [
        { "url": "._attachments/rbms/swagger_ztp_mgmt.yaml", "name": "ZTP
Management Server API Reference" },
        { "url": "._attachments/rbms/swagger_leitstand_template_engine.yaml",
"name": "Template Engine API Reference" },
        { "url": "._attachments/rbms/metric.yaml", "name": "Resource Inventory
Metric API" },
        { "url": "._attachments/rbms/meta.yaml", "name": "Resource Matadata API"
},
        { "url": "._attachments/rbms/jobs.yaml", "name": "Job Management API" },
        { "url": "._attachments/rbms/image.yaml", "name": "Resource Inventory
Image API" },
        { "url": "._attachments/rbms/group.yaml", "name": "Resource Inventory
Element Group API" },
        { "url": "._attachments/rbms/facility.yaml", "name": "Resource Inventory
Rack and Facility API" },
        { "url": "._attachments/rbms/element.yaml", "name": "Resource Inventory
Element API" },
        { "url": "._attachments/rbms/dns.yaml", "name": "DNS Zone API" },
        { "url": "._attachments/rbms/commons.yaml", "name": "commons" },
      ],
      dom_id: '#swagger-ui',
      deepLinking: true,
      docExpansion: "none",
      presets: [
        SwaggerUIBundle.presets.apis,
        SwaggerUIStandalonePreset
      ],
      plugins: [
        SwaggerUIBundle.plugins.DownloadUrl,
        DisableTryItOutPlugin
      ],
      layout: "StandaloneLayout"
    })
    // End Swagger UI call region
```

```
    window.ui = ui
  }
</script>
```

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