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SMRT® Link API use cases

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SMRT® Link web services API use cases

Introduction

The SMRT Link web services API, provided by PacBio®, allows integration of SMRT Link with third-party software. It is also used for designing runs, querying new data from the instrument, and starting secondary analyses.

This document describes common tasks performed using the SMRT Link web services API and provides "how to" examples for accomplishing these tasks.

This guide is applicable for **SMRT Link v25.1 and up** and **SMRT Link Cloud v25.3 and up**. SMRT Link and SMRT Link Cloud share similar source code. They primarily differ in how they are accessed and in API key generation. The following examples are for a local SMRT Link installation; however they can be adapted for SMRT Link Cloud by updating the URL for SMRT Link Cloud as shown in Accessing the API.

Accessing the API

SMRT Link

Note: For clarity, all of the API examples in this document use the unauthenticated, insecure endpoints. In a default SMRT Link installation, these are available from local hoston port 9091. If you are connecting from a remote host and/or you require SSL or authentication, you will instead go through the API gateway layer, which uses port 8243 and adds the prefix /SMRTLink/1.0.0. For example, with default installer settings, these two URLs refer to the same endpoint (assuming that the SMRT Link server is running on localhost):

```
http://localhost:9091/smrt-link/datasets/ccsreads
```

```
https://{dnsName}:8243/SMRTLink/1.0.0/smrt-link/datasets/ccsreads
```

Where `{dnsName}` references the fully qualified domain name.

SMRT Link Cloud

SMRT Link Cloud's API can be accessed at `https://smrtlink-api.sl.pacbcloud.com/smrt-link` The following example accessing an endpoint `https://smrtlink-api.sl.pacbcloud.com/smrt-link/import-run-design`

Viewing the API endpoints

Information on the SMRT Link web services API endpoints, including definitions and examples, is available as a Swagger page included with SMRT Link, accessible at:

SMRT Link: `https://{dnsname}:8243/sl/docs/services/#/default`

SMRT Link Cloud: `https://smrtlink.pacbcloud.com/docs/services/`

Not all endpoints are shared between SMRT Link and SMRT Link Cloud as SMRT Link Cloud does not include SMRT Analysis. Please reference your installations Swagger page for all available endpoints.

Connecting to the Services API securely

SMRT Link v25+ restricts access to the services port (Default = 9091) to clients running on localhost or connecting via the secure (HTTPS) API gateway on port 8243, with authentication credentials. The default API gateway combines NGINX for HTTPS, KrakenD for API management, and Keycloak for authentication.

If you **only** connect from localhost, the existing clients will continue to work as long as you specify localhost or 127.0.0.1and **not** the full host/domain name. If you are running any external database or automation programs that connect to the SMRT Link API, this section describes how to adapt your code to versions 25 and up.

Use caution when embedding user credentials in shell scripts or source code, as this may expose them in log files or shell history. We recommend that automated clients such as LIMS systems use a special- purpose account in Keycloak distinct from any system users. For example, the SMRT Link installation process automatically creates a user in Keycloak for the Revio® and Vega™ systems to use when connecting. Since this user is **only** known to the SMRT Link API gateway, it **cannot** be used for any purpose other than connecting to the SMRT Link API. Instructions for creating new SMRT Link users in Keycloak can be found in the SMRT Link 25 software installation guide.

Managing SMRT Link API tokens

Secure API access requires passing encoded authentication credentials in the HTTP header to a given endpoint URL. This is a two-step process: First the client requests an access token providing a valid username and password, then connects to the API endpoint using the access token. The token remains valid for up to two hours (7200 seconds), but several caveats about token expiry are discussed below.

1. POST a request to `https://{dnsName}:8243/token` with these HTTP headers:

   ```
   Content-Type: application/x-www-form-urlencoded
   Authorization: Basic
   S01MejVnN2ZibXg4UlZGS0tkdTBOT3JKaWM0YTo2TmpSWEJjRmZMWk93SGMwWGxpZGl6NHl3Y3Nh
   ```

   and this content, replacing <user> and <password> with the actual credentials:

   ```
   {
     "grant_type": "password",
     "username": "<user>",
     "password": "<password>",
     "scope": "welcome run-design run-qc openid analysis sample-setup data-
   management userinfo"
   }
   ```

   The "Basic" authorization identifies the client to the API gateway; for convenience we use hard-coded client registration credentials in SMRT Link, shown above. (The string passed here is a base-64 encoding of combined user and password strings.)

   The client response will look something like below: (This is an example of the response data model; the actual token string may be hundreds of characters long.)

```
{
  'access_token': '<ACCESS_TOKEN STRING>',
  'id_token': '<id_token>',
  'expires_in': 6272,
  'token_type': 'Bearer',
  'scope': 'analysis data-management openid run-design run-qc userinfo',
  'refresh_token': '<TOKEN STRING>'
}
```

2. Perform the API client call. The URL must now include the prefix `/SMRTLink/1.0.0`, and use HTTPS port `8243`. For example, these calls are equivalent:

   ```
   GET http://localhost:9091/status
   GET https://{dnsName}:8243/SMRTLink/1.0.0/status
   ```

   Also note that **all** service endpoints that were originally prefixed with /secondary-analysis now need to use /smrt-link instead, for example:

   ```
   GET http://localhost:9091/secondary-analysis/datasets/ccsreads
   ```

   now becomes:

   ```
   GET https://{dnsName}:8243/SMRTLink/1.0.0/smrt-link/datasets/ccsreads
   ```
   These HTTP headers are required, replacing <ACCESS`_TOKEN_STRING>`with the 'access_token' field's value from the response in Step 1:

   ```
   Content-type: application/json
   Authorization: Bearer <ACCESS_TOKEN_STRING>
   ```

3. The access token remains valid for the duration specified by expires_in (in seconds). In practice, we find it safest to refresh sooner than this to avoid clock skew issues. You can use the refresh token to request a new access_token instead of passing the user/password credentials:

   ```
   {
     "grant_type": "refresh_token",
     "refresh_token": "<refresh_token>"
   }
   ```

   This is posted to the same `/token` endpoint as in Step 1, with the same headers. Note however that if you have multiple clients running simultaneously, the refresh mechanism will effectively lead to a race condition, therefore re-authenticating each time is recommended if the clients are running for longer than the expiry time.

4. You can revoke an access token by POSTing to

   `/revoke`: POST https://{dnsName}:8243/revoke

   Use the same headers as Step 1, and this body:

   ```
   {
     "token": "<access_token>",
     "token_type_hint": "access_token"
   }
   ```

   This is what the **logout** button in SMRT Link does. It is not, however, necessary for non-browser client applications.

As a compact practical example, these Linux commands show how to use the secure API with the curl l and jq utilities

```
AUTH_TOKEN=$(curl -k -s -d
"grant_type=password&username=$API_USER&password=$API_PASS&scope=sample-setup+runs+data-
management+analysis+userinfo+openid" https://{dnsName}:8243/token | jq -r .access_token)

curl -k -s -H "Authorization: Bearer $AUTH_TOKEN"
https://{dnsName}:8243/SMRTLink/1.0.0/status
```

Here the `API_USER` and `API_PASS` variables should contain the actual user credentials; again, use caution when passing sensitive authentication information. Note that curl internally converts the hard-coded
`--user` credentials to the appropriate basic authorization header, and also sets the `Content-Type` header automatically.

SSL security features

The full SSL/HTTPS implementation includes several checks designed to prevent "man-in-the-middle" attacks by hackers, including the reliance on central certificating authorities to sign SSL keys, which are also tied to specific host names. The default SMRT Link installation uses a generic "self-signed" certificate that can optionally be replaced with a user-provided official certificate for that site. If this is **not** done, or if you encounter other problems with SSL security features, you may need to disable these features. This does not eliminate encryption or authentication, but it is generally discouraged by HTTP client libraries and tools. For example, in the shell commands shown in the previous section, the -k flag tells curl to disable SSL certificate verification.

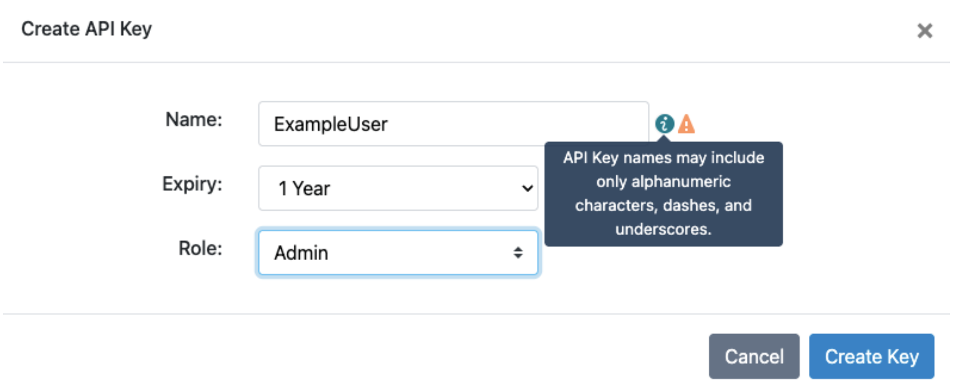
Python example

The following source code provides a complete working example of a simple authenticated client call using only the Python 3.7 standard library plus the request tts module, equivalent to the curl commands above:

```
class APIConstants(object):
    # These client registration credentials are valid for every SMRT Link
    # server (and are also used by the SL UI)
    SECRET = "KMLz5g7fbmx8RVFKKdu0NOrJic4a"
    CONSUMER_KEY = "6NjRXBcFfLZOwHc0Xlidiz4ywcsa"
    SCOPES = ["welcome", "run-design", "run-qc", "openid", "analysis",
              "sample-setup", "data-management", "userinfo"]

def _create_auth(secret, consumer_key):
    return base64.b64encode(":".join([secret, consumer_key]).encode("utf-8"))

def _get_token(url, user, password, scopes, secret, consumer_key):
    basic_auth = _create_auth(secret, consumer_key).decode("utf-8")
    headers = {
        "Authorization": "Basic {}".format(basic_auth),
        "Content-Type": "application/x-www-form-urlencoded"
    }
    scope_str = " ".join({s for s in scopes})
    payload = dict(grant_type="password",
                   username=user,
                   password=password,
                   scope=scope_str)
    # verify is false to disable the SSL cert verification
    return requests.post(url, payload, headers=headers, verify=False)

def get_smrtlink_auth_token(user, password, url):
    r = _get_token(url, user, password, APIConstants.SCOPES, APIConstants.SECRET,
APIConstants.CONSUMER_KEY)
    r.raise_for_status()
    j = r.json()
    access_token = j['access_token']
    refresh_token = j['refresh_token']
    scopes = j['scope'].split(" ")
    return access_token, refresh_token, scopes



def _to_headers(access_token):
    return {
        "Authorization": "Bearer {}".format(access_token),
        "Content-type": "application/json"
    }

def _get_endpoint(api_path, access_token):

    api_url = "https://{h}:8243/SMRTLink/1.0.0{p}".format(h=host, p=api_path)
    headers = _to_headers(access_token)

    # verify=False disables SSL verification
    response = requests.get(api_url, headers=headers, verify=False)
    response.raise_for_status()
    return response.json()

def get_status(hostname, user, password):
    token_url = "https://{h}:8243/token".format(h=host)
    access_token, refresh_token, scopes = get_smrtlink_auth_token(user, password,
token_url)
    return _get_endpoint("/status", access_token)
```

Managing SMRT Link Cloud API tokens

SMRT Link Cloud API tokens are managed in the SMRT Link Cloud GUI. In Settings > API keys, keys can be created and managed. When creating an API Key the name must only include alphanumeric characters, dashes, and underscores.


Create API Key

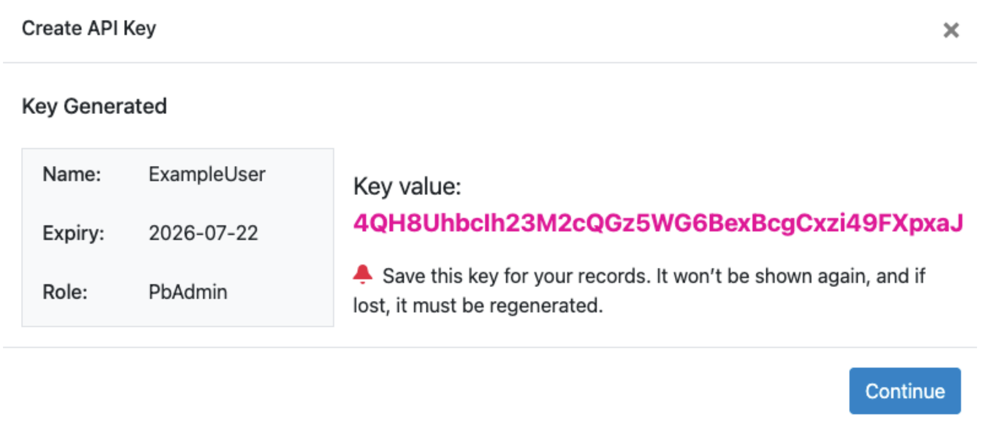
Name: ExampleUser

Expiry: 1 Year

Role: Admin

API Key names may include only alphanumeric characters, dashes, and underscores.

At creation, the API key is displayed only once. After creation, if the key is lost or forgotten a new key should be generated.


Create API Key

Key Generated

Name: ExampleUser

Expiry: 2026-07-22

Role: PbAdmin

Key value:
4QH8Uhbclh23M2cQGz5WG6BexBcgCxzi49FXpxaJ

Save this key for your records. It won't be shown again, and if lost, it must be regenerated.

From API Key Management, management options include enabling/disabling a key, deleting keys, editing keys, and regenerating keys

How to set up a run design

To set up a run design, perform the following steps:

1. Prepare the run design information in a CSV file, as documented in the SMRT Link user guide at https://www.pacb.com/support/software-downloads/. The SMRT Link distribution also includes a ZIP file containing template CSV files.

2. Create the run design: Use the POST request with the following endpoint:

```
POST /smrt-link/import-run-design
```

The payload (request body) for this POST request is a JSON string with either one of these fields:

- `path`: The path to the CSV file on the local or NFS file system.
- `content`: The raw content of the CSV file, as a string

Example

```
POST /smrt-link/import-run-design
{
    "path" : "/data/pacbio/run-csvs/my_run_20230201.csv"
}
```

This assumes that the server has read access to the specified path; if this is **not** possible, post the content directly.

The response will be the JSON object translated from CSV; the uuid field can be used to retrieve the run XML from this endpoint, which is also used by PacBio instruments:

```
GET /smrt-link/runs/<uuid>
```

For simple automation and testing, this endpoint is available on the Linux command line using the pbservice command:

```
pbservice import-run /data/pacbio/run-csvs/my_run_20230201.csv
```

How to get recent runs

To get recent runs, perform the following steps:

1. Get the list of all runs by using the GET request with the following endpoint:

```
GET /smrt-link/runs
```

2. Filter the response based on the value of the `createdAt`field. For example:

```
"createdAt": "2016-12-13T19:11:54.086Z"
```

Note: You may also search runs based on specific criteria, such as reserved state, creator, or summary substring.

Example: Find all runs created on or after 01.01.2017

First, get the list of all runs:

```
GET /smrt-link/runs
```

The response is an array of run objects, as in the following example: (Some fields are removed for display purposes.)

```
[
    {
        "name" : "54001_SAT",
        "uniqueId" : "a836efbc-fd58-40f6-b586-43c743730fe0",
        "createdAt" : "2016-11-08T17:50:57.955Z",
        "summary" : "SAT run"
    },
    {
        "name" : "54001_ecoli_15k",
        "uniqueId" : "798ff161-23ee-433a-bfd9-be8361b40f15",
        "createdAt" : "2017-01-20T16:08:41.610Z",
        "summary" : "E. coli assembly"
    },
    {
        "name" : "54001_hla_amplicons",
        "uniqueId : "5026afad-fbfa-407a-924b-f89dd019ca9f",
        "createdAt" : "2017-01-21T00:21:52.534Z",
        "summary" : "Human HLA"
    }
]
```

Now, search the above response for all run objects whose createdAt field starts with the 2017-01 substring. In the above example, you will get two runs that fit your criteria (that is, created on or after 01.01.2017):

- Run with "name" equal to "54001_ecoli_15k",
- Run with "name" equal to "54001_hla_amplicons".

How to monitor the progress of a SMRT Link run

Run progress can be monitored by looking at the completion status of each collection associated with that run. Perform the following steps:

1. If you do not have the Run UUID, retrieve it as described in Step 1 of [How to get recent runs](#).
2. Once you have the Run UUID, get all collections that belong to the run. Use the Run UUID in the GET request with the following endpoint:

   ```
   GET /smrt-link/runs/{runUUID}/collections
   ```

   The response contains the list of all collections of that run.
3. Monitor collection status to see when all collections are complete.

   Until all collections of the run have the field status set to Complete, repeat the GET request with the following endpoint:

   ```
   GET /smrt-link/runs/{runUUID}/collections
   ```

   You may also monitor each collection individually.

   Use the collection UUID in the GET request with the following endpoint:

   ```
   GET /smrt-link/runs/{runUUID}/collections/{collectionUUID}
   ```
4. To monitor run progress using QC metrics as well, do this at the collection level, for each collection that belongs to this run. For instructions, see [How to get QC reports for a specific collection](#).

The full set of QC metrics for a collection will be available **only** when the collection is **complete**. Monitor the completion status of each collection and, for each complete collection, check its QC metrics. QC metrics of all collections that belong to the run will let you evaluate the overall success of the run.

Example

To monitor the run with Name = `84001_SAT`, use the following steps:

1. Get the list of all runs as described in the previous section.

   ```
   GET /smrt-link/runs
   ```

   The response is an array of run objects, as in the following example: (Some fields are removed for display purposes.)

```
[
    {
        "name" : "84001_SAT",
        "uniqueId" : "a836efbc-fd58-40f6-b586-43c743730fe0",
        "createdAt" : "2023-12-18T17:50:57.955Z",
        "summary" : "SAT run"
    },
    {
        "name" : "84001_ecoli_15k",
```

```
        "uniqueId" : "798ff161-23ee-433a-bfd9-be8361b40f15",
        "createdAt" : "2023-01-20T16:08:41.610Z",
        "summary" : "E. coli assembly"
    },
    {

        "name" : "84001_hla_amplicons",
        "uniqueId" : "5026afad-fbfa-407a-924b-f89dd019ca9f",
        "createdAt" : "2023-01-21T00:21:52.534Z",
        "summary" : "Human HLA"
    }
]
```

Search the above response for the object with the name field equal to `84001_SAT`.

From the above example, you will get the run object with the `uniqueId` field equal to `a836efbc-fd58-40f6-b586-43c743730fe0`.

2. With this Run UUID = `a836efbc-fd58-40f6-b586-43c743730fe0`, get all collections that belong to this run:

   ```
   GET /smrt-link/runs/a836efbc-fd58-40f6-b586-43c743730fe0/collections
   ```

   The response is an array of collection objects of this run, as in the following example:

```
    [{
        "name" : "84001_SAT_1stCell",
        "instrumentName" : "Revio",
        "context" : "r84001_20231219_160902",
        "well" : "A01",
        "status" : "Complete",
        "instrumentId" : "84001",
        "startedAt" : "2023-12-19T16:12:47.014Z",
        "uniqueId" : "7cf74b62-c6b8-431d-b8ae-7e28cfd8343b",
        "collectionPathUri" : "/data/revio/r84001_20231219_160902/1_A01",
        "runId" : "a836efbc-fd58-40f6-b586-43c743730fe0",
        "movieMinutes" : 120
    }, {
        "name" : "84001_SAT_2ndCell",
        "instrumentName" : "Revio",
        "context" : "r84001_20231219_160902",
        "well" : "B01",
        "status" : "Ready",
        "instrumentId" : "84001",
        "startedAt" : "2023-12-19T16:12:47.014Z",
        "uniqueId" : "08af5ab4-7cf4-4d13-9bcb-ae977d493f04",
        "collectionPathUri" : "/data/revio/r84001_20231219_160902/2_B01",
        "runId" : "a836efbc-fd58-40f6-b586-43c743730fe0",
        "movieMinutes" : 120
    }
    ]
```

In the above example, the first collection has a `status` of `Complete`.

You can take its UUID, i.e. uniqueId: `7cf74b62-c6b8-431d-b8ae-7e28cfd8343b`, and get its QC metrics. For instructions, see How to get QC reports for a specific collection.

The second collection has a status of Ready.

You can take its UUID, i.e. uniqueId: `08af5ab4-7cf4-4d13-9bcb-ae977d493f04`, and monitor its status until it becomes Complete. To do so, use the following API call:

```
GET /smrt-link/runs/a836efbc-fd58-40f6-b586-
43c743730fe0/collections/08af5ab4-7cf4-4d13-9bcb-ae977d493f04
```

Once this collection becomes complete, you can get its QC metrics as well.

How to run jobs using services

SMRT Link runs several different types of "jobs" which consist of tasks that may run for different amounts of time to run, and are therefore executed asynchronously. To view a list of supported job types, enter:

```
GET /smrt-link/job-manager/job-types
```

```
  [
    {
      "jobTypeId": "db-backup",
      "description": "Create a DB backup of the SMRT Link system",
      "isQuick": true,
      "isMultiJob": false
    },
    {
      "jobTypeId": "delete-datasets",
      "description": "(Soft) delete of PacBio DataSet XML",
      "isQuick": true,
      "isMultiJob": false
    },
    ...
  ]
```

Note: "Quick" jobs (generally taking less than a minute) have their own queue, separate from analysis jobs and other I/O intensive tasks.

Creating a job follows this pattern:

```
POST /smrt-link/job-manager/jobs/<jobTypeId>
```

The request body varies depending on job type, from a single path field to more complex data types, several examples of which are described below. The server should respond with 201: Created and the model for the new job:

```
  {
    "name": "import-dataset",
    "updatedAt": "2018-06-19T21:13:31.047Z",
    "workflow": "{}",
    "path": "/smrtlink/userdata/jobs_root/000/000001",
    "state": "CREATED",
    "tags": "",
    "uuid": "7cf74b62-c6b8-431d-b8ae-7e28cfd8343b",
    "projectId": 1,
    "jobTypeId": "import-dataset",
    "id": 1,
    "smrtLinkVersion": "6.0.0.SNAPSHOT38748",
    "comment": "Description for job Import PacBio DataSet",
    "createdAt": "2018-06-19T21:13:31.047Z",
    "isActive": true,
    "createdBy": null,
    "isMultiJob": false,
    "jsonSettings":
"{\"path\":\"/data/sequel/r54001_20161219_160902/1_A01/m54001_20161219_170101.

consensusreadset.xml\",\"datasetType\":\"PacBio.DataSet.ConsensusReadSet\",\"submit\":true}",

    "jobUpdatedAt": "2018-06-19T21:13:31.047Z",
  }
```

Client code should now block until the job is complete, which should result in the state field changing to `SUCCESSFUL`if all goes well.

Note: Blocking mean that the client will poll for the server to complete a job. When the system is under minimal load, blocking can be used instead of manually polling for the job to complete. High-computational situations, such as a large FASTA file conversion, are **not** appropriate for blocking.

How to import a dataset

Once a run is complete and the data sets are transferred off the instrument, the resulting Data Set(s) are automatically imported into SMRT Link. To import a Data Set manually an import-dataset job must be run.

To import a Data Set, use this API call:

```
POST /smrt-link/job-manager/jobs/import-dataset
```

The request body in this case is very simple:

```
 {
  "path":
"/data/revio/r84001_20231219_160902/1_A01/r84001_20231219_160902_s1.consensusreadset.xml
"
 }
```

The server should respond with 201: `Created` and the model for the new job; it should only take several minutes at most for the import job to complete.

Note that the same `import-dataset` job type is also used to import other Data Set types such as the ReferenceSet XML used to run the SAT pipeline.

Searching for a Data Set

The Data Set retrieval endpoints support a number of search operators that may be included as CGI parameters:

```
GET /smrt-link/datasets/ccsreads?name=human
```

String fields use case-insensitive partial matching, so this will retrieve all Data Sets whose names include human in any combination of upper and lower case.

You can also retrieve a selection of Data Sets by posting a search query with a list of UUIDs:

```
POST /smrt-link/datasets/ccsreads
  {
    "uuid": "in:7cf74b62-c6b8-431d-b8ae-7e28cfd8343b,a836efbc-fd58-40f6-b586-
43c743730fe0"
  }
```

Note: The list needs to start with in: to tell the search API to find values from a list.

How to capture run-level summary metrics

Run-level summary metrics are captured in the QC reports. See the following sections:

- How to get QC reports for a specific SMRT Link run.
- How to get QC reports for a specific collection.

How to get SMRT Link Data Set reports by using the UUID

To get reports for a Data Set, given the Data Set UUID, perform the following steps:

1. Determine the Data Set type from the list of available types. Use the GET request with the following endpoint:

   ```
   GET /smrt-link/dataset-types
   ```

2. Get the corresponding Data Set type string. The Data Set type is in the `shortName` field.
3. Get reports that correspond to the Data Set. Given the Data Set UUID and the Data Set type, use them in the GET request with the following endpoint:

   ```
   GET /smrt-link/datasets/{datasetType}/{datasetUUID}/reports
   ```

Example

To get reports associated with a ccsreads with UUID = 146338e0-7ec2-4d2d-b938-11bce71b7ed1, perform the following steps:

Use the GET request with the following endpoint:

```
GET /smrt-link/dataset-types
```

You see that the shortName of ConsensusReadSet is ccsreads. The endpoint is:

```
/smrt-link/datasets/ccsreads/7cf74b62-c6b8-431d-b8ae-7e28cfd8343b/reports
```

Use the GET request with this endpoint to get reports that correspond to the

ConsensusReadSet with UUID = 7cf74b62-c6b8-431d-b8ae-7e28cfd8343b:

```
GET /smrt-link/datasets/ccsreads/7cf74b62-c6b8-431d-b8ae-7e28cfd8343b/reports
```

Once you have the UUID for an individual report, download it using the datastore files service with the uuid field:

```
GET /smrt-link/datastore-files/519817b6-4bfe-4402-a54e-c16b29eb06eb/download
```

How to get QC metrics for a specific collection

To retrieve the run QC metrics of a completed collection, given the collection UUID, perform the following steps:

1. Get the QC reports that correspond to this collection by using the GET request with the following endpoint:

   ```
   GET /smrt-link/runs/{runId}/collections/{collectionId}/qc
   ```

   See How to get SMRT Link reports for Data Sets by using the UUID for more details.

Note: Obtaining Data Set reports based on the collection UUID as described above will only work if the collection is **complete**. If the collection is **not** complete, then the ConsensusReadSet does not exist yet.

How to get QC and reports for a specific SMRT Link run

QC metrics for a run are stored as individual reports associated with a run's collection objects, and as a collated summary of metrics as is reported on the SMRT Link 'Runs Summary' page.

To get the summarized QC metrics for a specific run, given the run Name, perform the following steps:

1. Get the list of all runs by using the GET request with the following endpoint:

   ```
   GET /smrt-link/runs
   ```

   In the response, perform a text search for the run name: Find the object whose name field is equal to the run name, and get the Run UUID, which is found in the `uniqueId` field.

2. Get the QC metrics that belong to this run by using the Run UUID from the previous step in the GET request with the following endpoint:

   ```
   GET /smrt-link/runs/{runId}/qc
   ```

   The response will be an array of objects corresponding to the run's collections. Each collection object will contain that collection's QC metrics as individual fields.

The full QC reports can also be recovered through the dataset objects associated with a run. To get QC reports for a specific run, given the run Name, perform the following steps:

1. Get the list of all runs by using the GET request with the following endpoint:

   ```
   GET /smrt-link/runs
   ```

In the response, perform a text search for the run name: Find the object whose name field is equal to the run name, and get the Run UUID, which is found in the `uniqueId` field.

2. Get all collections that belong to this run by using the Run UUID found in the previous step in the GET request with the following endpoint:

   ```
   GET /smrt-link/runs/{runId}/collections
   ```

3. Take a collection UUID of one of collection objects received in the previous response. The collection UUIDs are in the `uniqueId` fields.

   Get the collection information by using the collection UUID from the previous step with a GET request to the following endpoint:

   ```
   GET /smrt-link/runs/{runId}/collections/{collectionId}
   ```

   Get the ConsensusReadSet UUID, which is found in the `ccsId` field

4. Make sure that the collection whose `uniqueId` field you take has the field status set to Complete. This is because obtaining qc reports based on the collection UUID as described below will **only** work if the collection is complete. If the collection is **not** complete, the ConsensusReadSet does **not** exist yet.

   You can now retrieve the Data Set reports that correspond to this collection as described in How to get SMRT Link reports for Data Sets by using the UUID.

5. Repeat Step 3 to download QC reports for all complete collections of that run.

Example

You view the Runs page in SMRT Link, and open the page of a run with a status of **Complete**. Take the run name and look for the Run UUID in the list of all runs, as described above.

Note: The Run ID also appears in the {runUUID} path parameter of the SMRT Link UI URL:

```
http://{dnsName}:9090/#/runs/{runUUID}
```

So the shorter way would be to take the Run UUID **directly** from the URL, such as

```
http://{dnsName}:9090/#/runs/a836efbc-fd58-40f6-b586-43c743730fe0 With this Run

UUID = a836efbc-fd58-40f6-b586-43c743730fe0, get all collections that

belong to this run: GET /smrt-link/runs/a836efbc-fd58-40f6-b586-

43c743730fe0/collections
```

Take a UUID of a completed collection, such as uniqueId: 59230aeb-a8e3-4b46-b1b1- 24c782c158c1. With this collection UUID, retrieve the ConsensusReadSet UUID:

```
GET /smrt-link/runs/{runId}/collections/{collectionId}
```

Use the ConsensusReadSet ID to get QC reports of the corresponding ConsensusReadSet:

```
GET /smrt-link/datasets/ccsreads/7cf74b62-c6b8-431d-b8ae-7e28cfd8343b/reports
```

Take a UUID of some report, such as uuid: 00c310ab-e989-4978-961e-c673b9a2b027. With this report UUID, download the corresponding report file:

GET /smrt-link/datastore-files/00c310ab-e989-4978-961e-c673b9a2b027/download

Repeat the last two API calls until you download all desired reports for all complete collections.

How to set up a SMRT Link analysis job for a specific workflow

To create an analysis job for a specific workflow, you need to create a job of type analysis with the payload based on the template of the desired pipeline. Perform the following steps:

1. Get the list of all pipeline templates used for creating analysis jobs:

   ```
   GET /smrt-link/resolved-pipeline-templates
   ```

2. In the response, search for the name of the specific pipeline to set up. Once the desired template is found, note the values of the pipeline `id` and `entryPoints` elements of that template.

3. Identify the Data Set(s) you want to use to run the analysis, and make note of the UUID(s).

4. For each entry point, find the corresponding record in the dataset-types endpoint, and extract the shortName field:

   ```
   GET /smrt-link/dataset-types
   ```

5. For each input Data Set, check whether a record already exists at the appropriate Data Set endpoint, and if one does not, it should be imported as described above. The Data Set endpoints take this form:

   ```
   GET /smrt-link/datasets/<shortName>/UUID
   ```

6. Build the request body for creating a job of type analysis. The basic structure looks like this:

   ```
   {
       "entryPoints": [
           {
               "datasetId": "5bd43ef4-6afe-dc62-4f49-03b75a051801",
               "entryId": "eid_ccsread",
               "fileTypeId": "PacBio.DataSet. ConsensusReadSet "
           },
           {
               "datasetId":  "1a369917-507e-4f70-9f38-69614ff828b6",
               "entryId": "eid_ref_dataset",
               "fileTypeId": "PacBio.DataSet.ReferenceSet"
           }
       ],
       "name": "Lambda SAT job",
       "pipelineId": "cromwell.workflows.pb_sat",
       "taskOptions": [],
       "workflowOptions": []
   }
   ```

   Use the pipeline `id` found in Step 2 as the value for the `pipelineId` element.

   Use Data Set types of the entryPoints array found in Step 1 and corresponding Data Set IDs found in Step 2 as the values for elements of the entryPoints array.

The Data Set IDs may be provided **either** as UUIDs (which are specified by the XML file and are independent of the server used) or integer IDs (which are generated by the server when the Data Sets are imported). In most cases the UUIDs will be easier to work with as they are known in advance.

Note that the `taskOptions` array is **optional** and may be completely empty in the request body. (`workflowOptions` is optional, and the contents are ignored by the server.)

7. Create a job of type `analysis`. Use the request body built in the previous step in the POST request with the following endpoint:

   ```
   POST /smrt-link/job-manager/jobs/analysis
   ```

8. You may monitor the state of the job created in Step 6 with the following request:

   ```
   GET /smrt-link/job-manager/jobs/analysis/{jobID}/events
   ```

   where `jobID` is equal to the value received in the `id` element of the response in Step 6.

Example

Suppose you want to set up an analysis job for the SAT pipeline.

First, get the list of all pipeline templates used for creating analysis jobs:

```
GET /smrt-link/resolved-pipeline-templates
```

The response is an array of pipeline template objects. In this response, do the search for the entry with name : Site Acceptance Test (SAT). The entry may look as in the following example: (Task options were truncated for clarity.). Please note the SAT analysis uses a tiny SubreadSet Data Set and not a ConsensusReadSet Data Set.

```
    {
        "name": "Site Acceptance Test (SAT)",
        "id" : "cromwell.workflows.pb_sat",
        "description": "Site Acceptance Test - lambda genome resequencing used
to validate new\n    PacBio installations",
        "version" : "0.1.0",
        "entryPoints": [
            {
                "entryId": "eid_ref_dataset",
                "fileTypeId": "PacBio.DataSet.ReferenceSet",
                "name": "Entry Name: PacBio.DataSet.ReferenceSet"
            },
            {
                "entryId": "eid_subread",
                "fileTypeId": "PacBio.DataSet. SubreadSet ",
                "name": "Entry Name: PacBio.DataSet. SubreadSet "
            }
        ],
        "tags" : [ "consensus", "mapping", "reports", "sat"],
        "taskOptions" : [{
            {
                "default": "",
                "description": "Dataset filter string",
                "id": "dataset_filters",
                "name": "Filters to add to the DataSet",
```

```
                "optionTypeId": "string"
            },
            {
                "default": 0,
                "description": "Downsampling Factor",
                "id": "downsample_factor",
                "name": "Downsampling Factor",
                "optionTypeId": "integer"
            }
        ]    }
```

In the above entry, take the value of the pipeline `id:cromwell.workflows`. Also take the Data Set types of `entryPoints` elements: `fileTypeId:PacBio.DataSet.SubreadSet` and `fileTypeId:PacBio.DataSet.ReferenceSet`. In this example we use the lambdaNEB reference and example PacBio data that are distributed with SMRT Link. First check whether they have been imported already:

```
GET /smrt-link/datasets/subreads/5bd43ef4-6afe-dc62-4f49-03b75a051801
```

```
  {
    "name": "lambda/0007_tiny",
    "updatedAt": "2015-10-26T22:54:46.000Z",
    "path": "opt/smrtlink-release_6.0.0.40259/admin/bin/../../bundles/smrtinub
/current/private/pacbio/canneddata/lambdaTINY/m150404_101626_42267_c1008079208
0000001823174110291514_s1_p0.subreadset.xml",
    "instrumentControlVersion": "2.3.0.1.142990",
    "tags": "",
    "instrumentName": "42267",
    "uuid": "5bd43ef4-6afe-dc62-4f49-03b75a051801",
    "totalLength": 16865720,
    "projectId": 1,
    "numRecords": 19930,
    "wellSampleName": "Inst42267-040315-SAT-100pM-2kb-P6C4",
    "bioSampleName": "unknown",
    "version": "3.0.1",
    "cellId": "unknown",
    "id": 5,
    "md5": "288d3bdadf83bda41dd7fefc11cad128",
    "importedAt": "2018-07-06T00:45:10.753Z",
    "jobId": 3,
    "createdAt": "2015-10-26T22:54:46.000Z",
    "isActive": true,
    "createdBy": "smrtlinktest",

    "wellName": "A01",
    "cellIndex": 4,
    "metadataContextId":
"m150404_101626_42267_c100807920800000001823174110291514_s1_p0",

    "numChildren": 0,
    "runName": "lambdaTINY",
    "datasetType": "PacBio.DataSet.SubreadSet",
    "comments":  "Inst42267-SAT-100pM-2kbLambda-P6C4-Std120_CPS_040315"

  }
```

```
GET /smrt-link/datasets/references/1a369917-507e-4f70-9f38-69614ff828b6
```

```
  {
    "name": "lambdaNEB",
    "updatedAt": "2015-10-24T03:32:50.530Z",
    "path": "opt/smrtlink-release_6.0.0.40259/admin/bin/../../bundles/smrtinub
/current/private/pacbio/canneddata/referenceset/lambdaNEB/referenceset.xml",
    "ploidy": "haploid",
    "tags": "",
    "uuid": "1a369917-507e-4f70-9f38-69614ff828b6",
    "totalLength": 48502,
    "projectId": 1,
    "numRecords": 1,
    "version": "3.0.1",
    "id": 4,
    "md5": "4861bca63e02aa26c92724febb3299c2",
    "importedAt": "2018-07-06T00:45:10.660Z",
    "jobId": 5,
    "createdAt": "2015-10-24T03:32:50.530Z",
    "isActive": true,
    "createdBy": "smrtlinktest",
    "organism": "lambdaNEB",
    "numChildren": 0,
    "datasetType": "PacBio.DataSet.ReferenceSet",
    "comments": "reference dataset comments"
  }
```

Build the request body for creating an `analysis` job for the SAT pipeline. Use the pipeline id obtained above as the value for the `pipelineId` element. Use the two Data Set UUIDs as values of the `datasetId` fields in the entryPoints array. For example:

```
{
        "pipelineId" : "cromwell.workflows.pb_sat",
        "entryPoints" : [
            {
                "datasetId": "5bd43ef4-6afe-dc62-4f49-03b75a051801",
                "entryId": "eid_subread",
                "fileTypeId": "PacBio.DataSet.SubreadSet"
            },
            {
                "datasetId":  "1a369917-507e-4f70-9f38-69614ff828b6",
                "entryId": "eid_ref_dataset",
                "fileTypeId": "PacBio.DataSet.ReferenceSet"
            }
        ],
        "taskOptions" : [],
        "workflowOptions": [],
        "name": "My SAT Job"
    }
```

Now create a job of type `analysis`. Use the request body built above in the following API call:

```
POST /smrt-link/job-manager/jobs/analysis
```

Verify that the job was created successfully. The return HTTP status should be `201 Created`.

How to query job history

The Job Service endpoints provide a number of search criteria (plus paging support) that can be used to limit the return results. A full list of available search criteria is provided in the the JSON Swagger API definition for the jobs endpoint. The following search retrieves all **failed** Site Acceptance Test (SAT) pipeline jobs:

```
GET /smrt-link/job-manager/jobs/analysis?state=FAILED&subJobTypeId=cromwell
```

For most data types, additional operators besides equality are allowed. For example:

```
GET /smrt-link/job-manager/jobs/analysis?createdAt=lt%3A2019-03-
01T00:00:00.000Z&createdBy=myusername
```

This retrieves all `analysis` jobs run before 2019-03-01 by a user with the login ID `myusername`.

Note: Certain searches, especially partial text searches using like:, may be significantly slower to execute and can overload the server if performed too frequently.

You can also perform bulk retrieval of jobs using the search endpoint:

```
POST /smrt-link/job-manager/jobs/analysis/search
  {
    "id": "in:1,2,3,4"
  }
```

The example above will retrieve jobs 1-4. You may also query on UUID or any other supported search field.

How to copy and rerun a SMRT Link analysis

The options endpoint for a specific job provides the POST content that ran it:

```
GET /smrt-link/job-manager/jobs/analysis/<jobId>/options
```

As is the case for Data Set IDs, **either** the UUID or the integer ID of the job can be provided. In this case, as both are generated automatically at job creation time, there is no preference for one or the other.

For example:

```
GET /smrt-link/job-manager/jobs/analysis/3/options

  {
    "name": "sat_lambda",
    "entryPoints": [
      {
        "entryId": "eid_ccsread",
        "fileTypeId":
        "PacBio.DataSet.ConsensusReadSet",
        "datasetId": 1
      },
      {
        "entryId": "eid_ref_dataset",
        "fileTypeId": "PacBio.DataSet.ReferenceSet",
        "datasetId": 2
      }
    ],
    "workflowOptions": [],
    "taskOptions": [],

    "pipelineId": "cromwell.workflows.pb_sat"
  }
```

This data model can be directly POSTed to the analysis job endpoint as described above. Note that in this case, the datasetId fields are the integer IDs generated by the SMRT Link database backend. You can retrieve the full Data Set records (including their UUIDs) by using the same Data Set endpoints described previously, only with the integer IDs instead of UUIDs:

```
GET /smrt-link/datasets/ccsreads/1
```

```
GET /smrt-link/datasets/references/2
```

How to run an analysis on all collections in a run

As explained earlier, each collection corresponds to a ConsensusReadSet Data Set. To run an analysis on multiple ConsensusReadSet combined, you can **either** first run a merge job to generate a single input, or let the analysis job perform the merge automatically.

For the two-step approach, perform the following steps:

1. As described previously, collect the UUIDs for the collections in the Run you want to analyze.
2. Check each collection UUID to make sure the ConsensusReadSet XML has already been imported, and if not, import it as described above:

   ```
   GET /smrt-link/datasets/ccsreads/<UUID>
   ```

3. Build a payload using the following model:

```
{
  "datasetType": "PacBio.DataSet.
  ConsensusReadSet ", "ids": ["<UUID1>",
  "<UUID2>", ...],
  "name": "Merge run <runId> collections"
}
```

4. Create a merge-datasets job with the request body from Step 3:

```
POST /smrt-link/job-manager/jobs/merge-datasets
```

5. Block until this job completes successfully, then retrieve the list of job datastore files. One of these should be the merged Data Set.

```
GET /smrt-link/job-manager/jobs/merge-datasets/<ID>/datastore
```

```
 [
   {
     "modifiedAt": "2018-07-12T21:38:34.815Z",
     "name": "Auto-merged hdfccsreads @ 1531431514119",
     "fileTypeId": "PacBio.DataSet. ConsensusReadSet",
     "path":
"/opt/smrtlink_5.1.0.14963/userdata/jobs_root/008/008767/merged.dataset.xml",
     "description": "Merged PacBio DataSet from 4 files",
     "uuid": "f54694da-5985-42b9-9a9e-f2190bd3b4a4",
     "fileSize": 33495,
     "importedAt": "2018-07-12T21:38:35.085Z",
     "jobId": 4,
     "createdAt": "2018-07-12T21:38:34.815Z",
     "isActive": true,
     "jobUUID": "127619b4-f615-4c3f-b208-e1bf52bfe21b",
     "sourceId": "pbscala::merge_dataset"

   },
   {
     "modifiedAt": "2018-07-12T21:38:34.264Z",
     "name": "SMRT Link Job Log",
     "fileTypeId": "PacBio.FileTypes.log",
     "path":
"/opt/smrtlink_5.1.0.14963/userdata/jobs_root/008/008767/pbscala-job.stdout",
     "description": "SMRT Link Job Log",
     "uuid": "b19fbfc6-0808-40fc-917b-092f369180cd",
     "fileSize": 388,
     "importedAt": "2018-07-12T21:38:34.266Z",
     "jobId": 8767,

     "createdAt": "2018-07-12T21:38:34.264Z",
     "isActive": true,
     "jobUUID": "127619b4-f615-4c3f-b208-e1bf52bfe21b",
     "sourceId": "analysis::master.log"
   }
 ]
```

6. You may now follow the steps for running an analysis job, using the new merged ConsensusReadSet as input.

To use the auto-merge capability, just submit the analysis job options with a separate eid_ccsread entry point for each input Data Set, for example:

```
GET /smrt-link/job-manager/jobs/analysis/3/options
{
  "name": "sat_lambda",
  "entryPoints": [
    {
      "entryId": "eid_ccsread",
      "fileTypeId": "PacBio.DataSet.
      ConsensusReadSet", "datasetId": "<UUID1>"
    },
    {
      "entryId": "eid_ccsread",
      "fileTypeId": "PacBio.DataSet.
      ConsensusReadSet", "datasetId": "<UUID2>"
    },
    {
      "entryId": "eid_ref_dataset",
      "fileTypeId": "PacBio.DataSet.ReferenceSet",
      "datasetId": "<REF_UUID>"
    }
  ],
  "workflowOptions": [],
  "taskOptions": [],
  "pipelineId": "cromwell.workflows.pb_sat"
}
```

Note that this process is opaque to Cromwell, which does **not** itself accept multiple inputs with the same identifier.

How to delete a SMRT Link job

To delete a job, you need to create another job of type delete-job, and pass the UUID of the job to delete in the payload (the request body).

Perform the following steps:

1. Build the payload for the POST request as a JSON with the following fields:

   - `jobId`: The UUID of the job to be deleted.
   - `removeFiles`: A boolean flag specifying whether to remove files associated with the job being deleted.
   - `dryRun`: A boolean flag to check whether it is safe to delete the job prior to actually deleting it.

   Note: To make sure that it is safe to delete the job (that is, there is no other piece of data dependent on the job being deleted), then first set the dryRun field to true and perform the API call described in Step 2 below. If the call succeeds, meaning that the job can be safely deleted, set the dryRun field to false and repeat the same API call again, as described in Step 3 below.

2. Check whether the job can be deleted, without actually changing anything in the database or on disk. Create a job of type delete-job with the payload which has dryRun = true; use the

POST request with the following endpoint:

```
POST /smrt-link/job-manager/jobs/delete-job
```

3. If the previous API call succeeded, that is, the job may be safely deleted, then proceed with actually deleting the job.

   Create a job of type delete-job with the payload which has dryRun = false; use the POST request with the following endpoint:

   ```
   POST /smrt-link/job-manager/jobs/delete-job
   ```

Suppose you want to delete the job with UUID = 13957a79-1bbb-44ea-83f3-6c0595bf0d42. Define the payload as in the following example, and set the dryRun field to true:

```
    {
        "jobId" : "13957a79-1bbb-44ea-83f3-6c0595bf0d42",
        "removeFiles" :true,
        "dryRun" : true
    }
```

Create a job of type `delete-job`, using the above payload in the following POST request:

```
POST /smrt-link/job-manager/jobs/delete-job
```

Verify that the response status is `201: Created`.

Also notice that the response body contains JSON corresponding to the job to be deleted, as in the following example:

```
    {
        "name" : "Job merge-datasets",
        "uuid" : "13957a79-1bbb-44ea-83f3-6c0595bf0d42",
        "jobTypeId" : "merge-datasets",
        "id" : 53,
        "createdAt" : "2016-01-29T00:09:58.462Z",

        ...
        "comment" : "Merging Datasets MergeDataSetOptions(PacBio.DataSet.
ConsensusReadSet, Auto-merged ccsreads @1454026198403)"
    }
```

Define the payload as in the following example, and this time set the dryRun field to false, to actually delete the job:

```
    {
        "jobId" : "13957a79-1bbb-44ea-83f3-6c0595bf0d42",
        "removeFiles" : true,
        "dryRun" : false
    }
```

Create a job of type delete-job, using the above payload in the following POST request:

```
POST /smrt-link/job-manager/jobs/delete-job
```

Verify that the response status is 201: Created. Notice that this time the response body contains JSON corresponding to the job of type delete-job, as in the following example:

```
{
    "name" : "Job delete-job",
    "uuid" : "1f60c976-e426-43b5-8ced-f8139de6ceff",
    "jobTypeId" : "delete-job",
    "id" : 7666,
    "createdAt" : "2017-03-09T11:51:38.828-08:00",
    ...
    "comment" : "Deleting job 13957a79-1bbb-44ea-83f3-6c0595bf0d42"
}
```

Clients should then block until the job is complete.

How to create and manipulate a Project

By default, **all** Data Sets and analyses are part of a "General Project" with global permissions. Creating new projects lets you organize related Data Sets and jobs and optionally restrict access to specific users using the SMRT Link UI. (**Note**: This is **only** enforced in the UI itself; the REST services do **not** currently restrict users to specific projects.)

The Projects service requires user credentials, which typically means going through the API gateway as described in How the authentication API works. Following is an example of how to create a project that contains two Data Sets and includes three users with varying levels of access:

```
POST /SMRTLink/1.0.0/smrt-link/projects
{
    "name": "Human Structural Variation",
    "description": "Human SV datasets and analyses",
    "state": "CREATED",
    "datasets": [
        {"id": 34},
        {"id": 45}
    ],
    "members": [
        {"login": "user1", "role": "OWNER"},
        {"login": "user2", "role": "CAN_EDIT"},
        {"login": "collaborator1", "role": "CAN_VIEW"}
    ],
}
```

The server will return the newly-created project including the integer ID that should be used in subsequent requests:

```
{
    "id": 2,
    "name": "Human Structural Variation",
    "description": "Human SV datasets and analyses",
    "state": "CREATED",
    "createdAt": "2020-06-01T11:51:38.828-08:00",
    "updatedAt": "2020-06-01T11:51:38.828-08:00",
    "isActive": true,
    "grantRoleToAll": null,
    "datasets": [
        {"id": 34},
        {"id": 45}
    ],
    "members": [
        {"login": "user1", "role": "OWNER"},
        {"login": "user2", "role": "CAN_EDIT"},
        {"login": "collaborator1", "role": "CAN_VIEW"}
    ]
}
```

If you do not want to manage user permissions individually, the field `grantRoleToAll` grants global access to the project if non-null.

You can retrieve details for a specific project by appending the integer ID to the URL, thus:

```
    GET /SMRTLink/1.0.0/smrt-link/projects/2
    {
        "id": 2,
        "name": "Human Structural Variation",
        ...
    }
```

To update project details, send a PUT request to this same URL with the modified version of the data model used to create the project. Use DELETE to soft-delete the project and reassign all of its Data Sets and jobs to the “General Project”.

Once you have a project ready to work with, any new job can be added to that project by overriding the `projectId` field to the job data model (the default is 1, the "General Project"). You may also add a `projectId` query argument when retrieving lists of jobs or Data Sets to filter the list to members of the specified project.

How to retrieve mapping report metrics from an analysis job

The jobs API provides an endpoint to retrieve report files:

```
  GET /smrt-link/job-manager/jobs/analysis/1001/reports

  [
    {
      "dataStoreFile": {
        "modifiedAt": "2020-12-07T10:14:03.121Z",
        "name": "Report mapping_stats_ccs",
        "fileTypeId": "PacBio.FileTypes.JsonReport",
        "path": "/data/smrtlink/jobs-root/cromwell-
executions/pb_align_ccs/00eae20b-f029-4a64-b882-8d95038ee89e/call-
ccs_mapping/mapping/fc30ff7d-de59-49d9-800d-dd25bf749704/call-
mapping_stats/execution/mapping_stats.report.json",
        "description": "PacBio Report mapping_stats_ccs (a7d394be-9a9a-457a-
b0ad-5d41a21a460b)",
        "uuid": "a7d394be-9a9a-457a-b0ad-5d41a21a460b",
        "fileSize": 7459,
        "importedAt": "2020-12-07T10:14:46.635Z",
        "createdAt": "2020-12-07T10:14:03.121Z",
        "isActive": true,
        "sourceId": "pb_align_ccs.report_mapping_stats"
      },
      "reportTypeId": "pb_align_ccs.report_mapping_stats"
    },
    {
      "dataStoreFile": {
        "modifiedAt": "2020-12-07T10:14:12.639Z",
        "name": "Report coverage",
        "fileTypeId": "PacBio.FileTypes.JsonReport",
        "path": "/data/smrtlink/jobs-root/cromwell-
executions/pb_align_ccs/00eae20b-f029-4a64-b882-8d95038ee89e/call-
ccs_mapping/mapping/fc30ff7d-de59-49d9-800d-dd25bf749704/call-

coverage_reports/coverage_reports/408518ac-80e5-4f48-9185-ed1b51fe43c6/call-
pbreports_coverage/execution/coverage.report.json",
        "description": "PacBio Report coverage (52adc5b2-b1b9-4e27-9ae4-
94de2a525b1e)",
        "uuid": "52adc5b2-b1b9-4e27-9ae4-94de2a525b1e",

        "fileSize": 2596,
        "importedAt": "2020-12-07T10:14:46.635Z",
        "createdAt": "2020-12-07T10:14:12.639Z",
        "isActive": true,
        "sourceId": "pb_align_ccs.report_coverage"
      },
      "reportTypeId": "pb_align_ccs.report_coverage"
    }
  ]
```

For workflows that produce a mapping report, it will typically have a `reportTypeId` of the form `workflow_id.report_mapping_stats`, in this case `pb_align_ccs.report_mapping_stats`. We can then retrieve the full report by adding the UUID to the URL:

```
  GET /smrt-link/job-manager/jobs/analysis/1001/reports/a7d394be-9a9a-457a-
b0ad-5d41a21a460b
```

```
  {
    "version": "1.0.1",
    "id": "mapping_stats_ccs",
    "_comment": "Generated with pbcommand version  at 2020-12-
07T02:14:03.119926",
    "title": "Report mapping_stats_ccs",
    "attributes": [
      {
        "id": "mapping_stats_ccs.blast_identity",
        "name": "Mean Concordance (mapped)",
        "value": 0.8919674526217451
      },
      ...
    ]
  }
```

Mean Concordance (mapped) in the SMRT Link UI is blast_identity (after converting to a percentage value). This Python snippet shows an alternative approach to retrieving several metrics like this from the report JSON file, bypassing the final API call:

```
.. code-block:: python

  import os.path
  from pbcommand.pb_io import load_report_from_json
```

```
def get_mapping_metrics(report_file):
    report = load_report_from_json(report_file)
    keys = {"blast_identity", "mapped_reads_n", "mapped_readlength_mean"}
    return {a.id:a.value for a in report.attributes if a.id in keys}
```