Illumina NovaSeq LIMS API v1



Contents

[1 Document Versions 3](#_Toc2759508)

[2 Introduction 4](#_Toc2759509)

[3 API Specification 4](#_Toc2759510)

[4 DTO Submission Retries 4](#_Toc2759511)

[4.1 Login URL Retrieval 4](#_Toc2759512)

[4.2 Recipe Retrieval 5](#_Toc2759513)

[4.3 Providing Run Metrics 5](#_Toc2759514)

[4.4 Providing Run Progress 6](#_Toc2759515)

[5 DTOs and Structures 6](#_Toc2759516)

[5.1 RecipeRequestDTO 6](#_Toc2759517)

[5.2 RecipeRequestResponseDTO 7](#_Toc2759520)

[5.3 SequencingRunMetrics 8](#_Toc2759521)

[5.4 SequencingRunStatusDTO 9](#_Toc2759522)

[5.5 RunInfo 10](#_Toc2759525)

[5.6 Reagent 11](#_Toc2759526)

[5.7 Enumeration: SequencingRunStatus 12](#_Toc2759527)

[5.8 Enumeration: SequencingInstrumentType 12](#_Toc2759528)

[5.9 Enumeration: LimsErrors 12](#_Toc2759529)

[6 Authentication 13](#_Toc2759530)

[7 Login Page and Redirect URL 13](#_Toc2759531)

[8 Change History 14](#_Toc2759532)

# Document Versions

|  |  |
| --- | --- |
| 1.3 | NVCS 1.6 support |
| 1.2 | NVCS 1.5.1 support |
| 1.1 | NVCS 1.5 support |
| 1.0 | Initial release |

# Introduction

The NovaSeq line of sequencers provides support for an external LIMS system. Illumina has developed an API that can be used by an external LIMS system to interact with a NovaSeq instrument. This document describes this API, along with authentication details that are required to successfully interoperate with a NovaSeq instrument.

# API Specification

The NovaSeq LIMS API is a REST API that a given LIMS service must implement. The NovaSeq Control Software calls the endpoints of this API at specific times during sequencing run setup and progression. All interactions with the LIMS system are conducted through this API, with the notable exception of user login which is covered in Login Page and Redirect URL.

# DTO Submission Retries

The NovaSeq sequencer attempts to retry DTO submission to the LIMS service when a submission is unsuccessful. Retries use a doubled-wait pattern, in which a retry is made after one second, then two seconds, continuing to double to a maximum delay between retries of 15 minutes. Synchronous calls generate an error after 60 seconds of retries. Asynchronous calls retry indefinitely using the doubled-wait retry pattern, until the user returns to the home screen. All LIMS messages are lost when the user returns to the home screen.

## Login URL Retrieval

Figure 1 - Retrieving Login URL

|  |  |
| --- | --- |
| Purpose | The LIMS service provides a URL to the Login Server, which is used to access the user authentication token that is used for the remainder of the sequencing run. |
| URL | Illumina/Sequencer/v2/sequencing-run/login |
| Method | GET |
| Success Response | A string representation of the login URL, e.g. “https://localhost:9001” |

The URL returned should be a well-formed, usable URL, such as <https://localhost:9001>. The NovaSeq Control Software uses this URL to furnish the user login page during sequencing setup.

## Recipe Retrieval

Figure 2 - LIMS Recipe Retrieval

|  |  |
| --- | --- |
| Purpose | The LIMS service provides the information required to successfully setup a NovaSeq recipe and sequencing run. |
| URL | Illumina/Sequencer/v2/sequencing-run/recipe/novaseq |
| Method | POST |
| DTO | {  RecipeRequestDTO (see DTOs and Structures below)  } |
| Success Response | {  RecipeRequestResponseDTO (see DTOs and Structures below)  } |
| Error Response | HTTP Error Code (i.e. 4xx), plus a payload of the form:  {  LimsErrors[]  } |

The NovaSeq Control Software sends a DTO with the library container ID and, in certain scenarios, the flow cell ID. LIMS sends back a DTO populated with information needed to setup a NovaSeq sequencing run.

## Providing Run Metrics

Figure 3 - Submitting Run Metrics

|  |  |
| --- | --- |
| Purpose | NovaSeq Control Software provides run metrics on successful completion of a sequencing run. |
| URL | Illumina/Sequencer/v2/sequencing-run/metrics |
| Method | POST |
| DTO | {  SequencingRunMetrics (see DTOs and Structures below)  } |
| Success Response | HTTP Status Code |

## Providing Run Progress

Figure 4 - Submitting Run Progress

|  |  |
| --- | --- |
| Purpose | NovaSeq Control Software provides run progress updates throughout a sequencing run. |
| URL | Illumina/Sequencer/v2/sequencing-run/update |
| Method | POST |
| DTO | {  SequencingRunStatusDTO (see DTOs and Structures below)  } |
| Success Response | HTTP Status Code |

# DTOs and Structures

The following DTOs and structures are sent by the NovaSeq Control Software to the LIMS service throughout a sequencing run.

## RecipeRequestDTO

Figure 5 - RecipeRequestDTO

|  |  |  |
| --- | --- | --- |
| **NAME** | **TYPE** | **INFO** |
| FlowCellId | string | A string representation of the flow cell barcode, e.g. H7GWDMCVY. |
| LibraryContainerId | string | A string representation of the library tube barcode, e.g. NV0001375-LIB. |
| Reagents | Reagent[] | An array of Reagent objects, defined below. |

When retrieving a RecipeRequestResponseDTO, it is important to be aware of the NovaSeq run modes, and how they correlate to recipe requests. The following rules apply.

Figure 6 – Run Mode Rules with RecipeRequestDTO

|  |  |
| --- | --- |
| **RUN MODE** | **RULE** |
| NovaSeq XP | Specify only FlowCellId in RecipeRequestDTO. |
| NovaSeq Standard | Specify only LibraryContainerId in RecipeRequestDTO. |

## RecipeRequestResponseDTO

Figure 7 - RecipeRequestResponseDTO

|  |  |  |
| --- | --- | --- |
| **NAME** | **TYPE** | **INFO** |
| run\_name | string | A non-whitespace string consisting of only letters, digits, ‘\_’ and ‘-‘. |
| run\_mode | string | A string representation of one of the following values:   * S2, * S1, * HTWashOnly , * LTWashOnly, * S4, * SP |
| workflow\_type | string | A string representation of one of the following values:   * NoIndex, * SingleIndex, * DualIndex * Custom |
| librarytube\_id | string | A string representation of the library tube barcode, e.g. NV0001375-LIB |
| flowcell\_id | string | A string representation of the flow cell barcode, e.g. H7GWDMCVY |
| sample\_loading\_type | string | A string representation of one of the following values:   * NovaSeqStandard, * NovaSeqXp |
| rehyb | bool | Not currently used. Default value is false. |
| paired\_end | bool | A Boolean that is true if the run is a paired-end run. |
| read1 | int | The number of cycles in read 1. The number cannot be less than 2. The total of all read cycles cannot be greater than the number of cycles supported by the reagent kit. |
| read2 | int | The number of cycles in read 2. The number cannot be equal to 1. The total of all read cycles cannot be greater than the number of cycles supported by the reagent kit. |
| index\_read1 | int | The number of cycles in index read 1. The number cannot be:   * Equal to 1 * Greater than 20   The total of all read cycles cannot be greater than the number of cycles supported by the reagent kit |
| index\_read2 | int | The number of cycles in index read 1. The number cannot be:   * Equal to 1 * Greater than 20   The total of all read cycles cannot be greater than the number of cycles supported by the reagent kit |
| output\_folder | string | A string representation of the run output folder on the local NovaSeq system. |
| samplesheet | string | A URI representation of the path to the sample sheet file. The URI can point to an authenticated or unauthenticated endpoint. When using an authenticated endpoint, require\_samplesheet\_authentication must be set to true. It is expected that the sample sheet URI expires when the OAuth token expires. |
| require\_samplesheet\_authentication | Bool | A Boolean that is true if the sample sheet URI requires an OAuth token. If true, the OAuth token provided by the login is used to interact with the sample sheet endpoint. If the DTO does not specify this field, it defaults to false. |
| usecustomrecipe | bool | A Boolean that is true if the run is using a custom recipe. |
| customRecipe | string | A string representation of the path to the custom recipe. |
| use\_basespace | bool | A Boolean that is true if the run is using BaseSpace. |
| basespace\_mode | string | A string representation of one of the following values:   * RunMonitoringAndStorage * RunMonitoringOnly |
| use\_custom\_read1\_primer | bool | A Boolean that is true if the run is using a custom read 1 primer. |
| use\_custom\_read2\_primer | bool | A Boolean that is true if the run is using a custom read 2 primer. |
| use\_custom\_index\_read1\_primer | bool | A Boolean that is true if the run is using a custom index read 1 primer. |

## SequencingRunMetrics

Figure 8 - SequencingRunMetrics

|  |  |  |
| --- | --- | --- |
| **NAME** | **TYPE** | **INFO** |
| RunInfo | RunInfo | A RunInfo object, defined below. |
| Status | SequencingRunStatus | A SequencingRunStatus value, defined below. |
| YieldPfR1 | float | A float value representing the amount of the read 1 yield passing filter. |
| YieldPfR2 | float | A float value representing the amount of the read 2 yield passing filter. |
| ReadsPfR1 | float | A float value representing the number of read 1 clusters passing filter. |
| ReadsPfR2 | float | A float value representing the number of read 2 clusters passing filter. |
| ClusterDensityR1 | float | A float value representing the read 1 cluster density. |
| ClusterDensityR2 | float | A float value representing the read 2 cluster density. |
| PercentPfR1 | float | A float value representing the read 1 percent passing filter. |
| PercentPfR2 | float | A float value representing the read 2 percent passing filter. |
| PercentGreaterThanQ30R1 | float | A float value representing the read 1 percent greater than Q30. |
| PercentGreaterThanQ30R2 | float | A float value representing the read 2 percent greater than Q30. |
| IntensityCycle1R1 | float | A float value representing the read 1 cycle 1 intensity. |
| IntensityCycle1R2 | float | A float value representing the read 1 cycle 2 intensity. |
| PercentAlignedR1 | float | A float value representing the read 1 percent aligned. |
| PercentAlignedR2 | float | A float value representing the read 2 percent aligned. |
| PercentErrorRateR1 | float | A float value representing the read 1 percent error rate. |
| PercentErrorRateR2 | float | A float value representing the read 2 percent error rate. |
| PercentPhasingR1 | float | A float value representing the read 1 percent phasing. |
| PercentPhasingR2 | float | A float value representing the read 2 percent phasing. |
| PercentPrePhasingR1 | float | A float value representing the read 1 percent prephasing. |
| PercentPrePhasingR2 | float | A float value representing the read 2 percent prephasing. |

## SequencingRunStatusDTO

Figure 9 - SequencingRunStatusDTO

|  |  |  |
| --- | --- | --- |
| **NAME** | **TYPE** | **INFO** |
| RunInfo | RunInfo | A RunInfo object, defined below. |
| Status | SequencingRunStatus | A SequencingRunStatus value, defined below. |
| Reagents | Reagent[] | An array of Reagent objects, defined below. |
| CurrentCycle | int | The currently executing cycle. |
| CurrentRead | int | The currently executing read. |
| InstrumentControlSoftwareVersion | string | The version of the control software. |
| RtaVersion | string | The version of RTA. |
| FirmwareVersion | string | The version of the firmware. |

## RunInfo

Figure 10 - RunInfo

|  |  |  |
| --- | --- | --- |
| **NAME** | **TYPE** | **INFO** |
| RunId | string | A string that follows a configurable template, which defaults to “{YY}{MM}{DD}\_{SERIAL}\_{RUN}\_{FCPOS}{FCSERIAL}”,  where:   * YY = year * MM = month * DD = day * Serial = instrument name * Run = total number of sequencing runs on the instrument * FCPOS = flow cell side, ‘A’ or ‘B’ * FCSERIAL = flow cell barcode |
| FlowCellId | string | A string representation of the flow cell barcode, e.g. H7GWDMCVY. |
| LibraryTubeId | string | A string representation of the library tube barcode, e.g. NV0001375-LIB. |
| InstrumentId | string | The name of the instrument. |
| InstrumentType | SequencingInstrumentType | A value from the SequencingInstrumentType enum, defined below. |
| FlowCellSide | string | A string representation of the flow cell side. Value can be one of the following:   * Left * Right |
| DateTime | DateTime | The expiration date of the reagent kit, formatted in the standard ISO 8601 format:  YYYY-MM-DDThh:mm:ss.sTZD  Where:   * YYYY = four-digit year * MM = two-digit month (01=January, etc.) * DD = two-digit day of month (01 through 31) * hh = two digits of hour (00 through 23) (am/pm NOT allowed) * mm = two digits of minute (00 through 59) * ss = two digits of second (00 through 59) * s = one or more digits representing a decimal fraction of a second * TZD = time zone designator (Z or +hh:mm or -hh:mm)   For example: 2018-05-16T07:07:23.3842218-07:00 |
| OutputFolder | string | A string representation of the run output folder on the local NovaSeq system. |
| UserName | string | The user name of the LIMS logged in user. |

## Reagent

Figure 11 - Reagent

|  |  |  |
| --- | --- | --- |
| **NAME** | **TYPE** | **INFO** |
| Name | string | A string representation of one of the following values:   * Flow Cell, * SBS, * Library Tube, * Cluster, * Buffer |
| ExpirationDate | DateTime | The expiration date of the reagent kit, formatted in the standard ISO 8601 format:  YYYY-MM-DDThh:mm:ss.sTZD)  Where:   * YYYY = four-digit year * MM = two-digit month (01=January, etc.) * DD = two-digit day of month (01 through 31) * hh = two digits of hour (00 through 23) (am/pm NOT allowed) * mm = two digits of minute (00 through 59) * ss = two digits of second (00 through 59) * s = one or more digits representing a decimal fraction of a second * TZD = time zone designator (Z or +hh:mm or -hh:mm)   For example: 2018-05-16T07:07:23.3842218-07:00 |
| LotNumber | string | The lot number of the reagent kit. |
| SerialNumber | string | The serial number of the reagent kit. |
| PartNumber | string | The part number of the reagent kit. |
| Mode | string | A string representation of one of the following values:   * S2, * S1, * HTWashOnly, * LTWashOnly, * S4, * SP |
| Cycles | int | The supported cycles of the reagent kit. |

In addition to the above, two enumerations are defined for LIMS communications.

## Enumeration: SequencingRunStatus

Figure 12 - SequencingRunStatus Enumeration

SequencingRunStatus

{

RunStarted,

RunEndedByUser,

RunErroredOut,

RunCompletedSuccessfully

}

## Enumeration: SequencingInstrumentType

Figure 13- SequencingInstrumentState Enumeration

SequencingInstrumentType

{

NovaSeq6000

}

## Enumeration: LimsErrors

Figure 13- LimsErrors Enumeration

LimsErrors

{

GeneralLimsFailure,

FlowCellLotNumberIssue,

FlowCellBarcodeNotFound,

LibraryTubeLotNumberIssue,

LibraryTubeBarcodeNotFound,

SbsLotNumberIssue,

SbsBarcodeNotFound,

ClusterLotNumberIssue,

ClusterBarcodeNotFound,

BufferLotNumberIssue,

BufferBarcodeNotFound

}

# Authentication

The NovaSeq Control Software uses the OAuth 2.0 framework, providing bearer tokens for authentication. Specifically, the LIMS furnished login page displayed in the NovaSeq Control Software provides an access token via redirect URL upon successful login.

A token expiration time of at least 88 hours is recommended.

# Login Page and Redirect URL

When requested, the LIMS service provides NovaSeq Control Software with a URL for a login page. The NovaSeq Control Software does not store any usernames or passwords used in the login page. It uses the token provided for authentication.

As with most LIMS situations, there is a need for user tracking. Since the NovaSeq Control Software does not save any user provided login information, the login server needs to return, in addition to the token, the username.

The server shall provide the token and username by returning them in redirect URL upon successful login. The redirect URL itself does not have to be an existing resource—it needs to contain the access token and username in the expected format (shown in Figure 14). In addition, the NovaSeq Control Software requires the redirect URL to contain the return status of user login, which is either Success or Error.

The following is an example of a redirect URL that the NovaSeq Control Software expects on successful login to LIMS:

Figure 14 – Successful Login Redirect URL

**https://limsserverlurl.illumina.com/Success?accessToken= sampleToken&userName= user**

When the LIMS user login fails or the server encounters an error on login, the NovaSeq Control Software expects the redirect URL to contain the word ERROR. Upon identifying an error status on login, the NovaSeq Control Software does not attempt to retrieve the username and access token.

Figure 15 – Unsuccessful Login Redirect URL

**https://limsserverlurl.illumina.com/Error?accessToken=&userName=**

# Change History

|  |  |  |  |
| --- | --- | --- | --- |
| Version | ER# | Originator | Description of Change |
| 00 | DIR Workflow | Jeremy Myslinski | Initial Release |
| 01 | DIR Workflow | Jeremy Myslinski | Revised LIMS API Document to include changes in the LIMS API used in NovaSeq Control Software 1.5.0. |
| 02 | DIR Workflow | Srdan Mihajlovic | Revised LIMS API Document to include changes in the LIMS API used in NovaSeq Control Software 1.5.1 |
| 03 | DIR Workflow | Jeremy Myslinski | Revised LIMS API Document to include changes in the LIMS API used in NovaSeq Control Software 1.6.0 |