

User Manual for openBIS

8.04.4



CISD
Center for
Information Sciences
and Databases

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Author: CISD, <http://www.cisd.systemsx.ethz.ch/>

This manual is addressed to users and application administrators of openBIS. It is not a documentation for system administrators.

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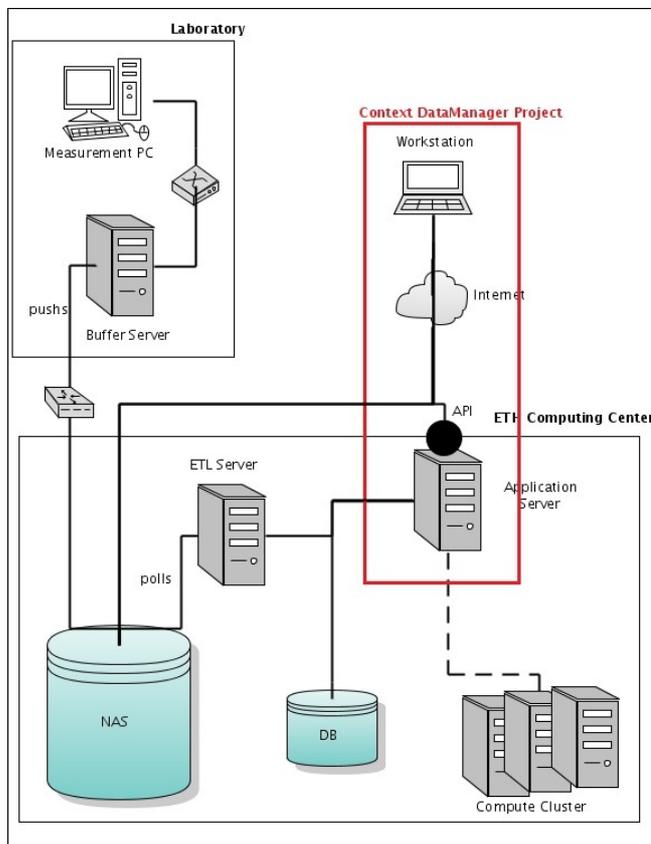
User Guide

The siRNA Image Management System is a client server application managing and processing image data generated in siRNA screens.

Parts

The current version consists of

- A DB Server
- An Application Server that controls authentication and database access via Web Services, provided over Secure Socket Layers
- The [CISD authentication service](#) (same accounts as for the Wiki and the [Issue Tracker](#))
- A console client offering "commands" or "methods" to the user
- A buffer or overflow server infrastructure staging the image data locally if necessary due to network instabilities
- A Datamover moving file-based raw data produced by some local data producer (typically a measurement device) to a (remote) central storage, in this case to the NAS of ETHZ
- An ETL server that registers the images with the DB and thereby associating the data, i.e. images, with the corresponding experimental procedures



Prerequisites and Installation

To be able to run the command line client Java 5 (sometimes ambiguously called Java 1.5) or Java 6 (sometimes called Java 1.6) must be installed. To check, enter:

```
C:\> java -version
```

on the command line. The systems should return something like:

```
java version "1.6.0.01"  
Java(TM) SE Runtime Environment (build 1.6.0_01-b06)  
Java HotSpot(TM) Client VM ((build 1.6.0_01-b06, mixed mode, sharing)
```

To be able to log in, you need a SystemsX.ch account and you need to be member of the `lims-users` group, unless that is the case please contact CISD for assistance. A SystemsX.ch account will give you access rights to all applications hosted by CISD, e.g. the SystemsX.ch Wiki and the issue tracking system.

1. The application server is available at <https://sprint-openbis.ethz.ch/openbis>. Just click on this link to sure that the server is available.
2. Download the current client release and unpack it.
3. Open a command line prompt and change into the `openBIS-client` directory.

```
D:\somewhere> cd openBIS-client
```

4. Open a session to the application server by typing:

```
D:\somewhere\openBIS-client> bis login
```

running the shell script, e.g. `bis.sh` (for OS Linux) or `bis.bat` (for OS Windows) calling the `login` method. Both scripts are provided by the `zip` file.

openBIS Tutorial

This tutorial presents an example for the standard workflow (so called *strict* workflow) for siRNA High Content Screening needed to get a new experiment registered.

First, a brief overview about the concepts and terms:

- An *experiment* is related to a *project*. A project can have many experiments.
- By registering an experiment *cell plates* or *re-infection plates* have to be specified. Optional also *processing instructions* can be specified.
- A re-infection plate is derived from a cell plate.
- A cell plate is derived from a *dilution plate*.
- A dilution plate is derived from a *master plate*.
- Each plate can be associated with a *control layout*.
- The generic term for plates and control layouts is *sample*.
- Samples are organized in *wells* which are ordered in a rectangular fashion called *plate geometry*.
- Well can be associated with a *material* of a certain *material type*. Control layout wells are associated with materials of type CONTROL. Wells of master plates are associated with materials of type OLIGO or COMPOUND. The wells for all other types of plates will be inherited from the master plate from which the plate is derived from.
- A materials, samples, and experiments can have zero or more *properties*.
- A property has a certain *property type* which specifies the unique property name (called *property code*), the data type, and whether it is mandatory or not.
- Materials of type OLIGO are associated with materials of type GENE.

Note:

- You have to `login` before you can do anything useful.
- You have to have at least USER privileges (for some commands even ADMIN).
- Often *tab-separated* files are needed in many commands. Such a file contains a table of values. Tab-separated files are easily created with Excel by just saving a spread sheet as 'Text (Tab delimited)'. Try to avoid special characters in the file naming. To avoid surprises, only uses letters, numbers and underscore. If you can not do so, put the file in quotes (").

Register Properties

For experiments, materials, and samples you can assign additional properties, beside of the already defined ones.

The following paragraphs show how you can assign properties to materials. But this also works for experiments and samples.

First, you should get an overview of the available types and their associated property types by using the commands `list-material-types` and `get-material-type-info`:

```
prompt> bis list-material-types -P
Code      | Description
-----|-----
BACTERIUM | Bacterium
CELL_LINE | Cell Line or Cell Culture. The growing of cells under controlled conditions.
COMPOUND  | Compound
CONTROL   | Control of a control layout
GENE      | Gene
OLIGO     | Oligo nucleotide
VIRUS     | Virus
(7 rows)

prompt> bis get-material-type-info CONTROL -P
Properties of materials of type CONTROL
Code      | Label      | Data Type      | M[...] | Description      | Registrator      | Registration Date
-----|-----|-----|-----|-----|-----|-----
USER.COLOR | Color      | VARCHAR        | no     | Material Color  | Darwin, Charles [darwin] | 2008-02-19 13:23:59 GMT+01:00
USER.DESCRPTION | Description | VARCHAR        | no     | A Description   | System User [system] | 2007-12-19 15:43:20 GMT+01:00
USER.SKINCOLOR | Color(1)   | CONTROLLEDVOCABULARY(USER.COLOR) | no     | Color of material | Einstein, Albert [einstein] | 2008-02-28 10:11:21 GMT+01:00
(3 rows)
prompt>
```

If the material type has already all properties you think are necessary for your purpose you can skip the following subsections.

Register Property Type

Registering properties and assigning them to certain material types needs ADMIN privileges.

The command `list-property-types` lists the available property types:

```
prompt> bis list-property-types -P
Property Types
```

Code	Label	Data Type	Registrator	Registration Date
USER.CELLLINE_NAME	Cell line	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.COLOR	Color	VARCHAR	Darwin, Charles [darwin]	2008-02-19 12:35:03 GMT+01:00
USER.DESCRPTION	Description	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.GENE_SYMBOL	Gene Symbol	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.NUCLEOTIDE_SEQUENCE	Nucleotide Sequence	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.OFFSET	Offset	INTEGER	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.ORG	organism	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.REFSEQ	RefSeq	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.SKINCOLOR	Color(1)	CONTROLLEDVOCABULARY (USER.COLOR)	Einstein, Albert [einstein]	2008-02-28 10:10:15 GMT+01:00

(9 rows)
prompt>

If none of them can be used to assign a new property type to a certain material type a new property type has to be defined by the command `register-property-types`. As a prerequisite a tab-separated file like the following has to be prepared:

property-types.txt

code	label	data_type	description
USER.VENDOR	Vendor	VARCHAR	Vendor of a material

Note, that the code of a property has to start with `USER.` in order to distinguishes it from internally defined properties.

Now, executing the registration command with this file leads to:

```
prompt> bis register-property-types property-types.txt
Registering property types from 'D:\User\felmer\tmp\sprint-demo\openBIS-client\property-types.txt'.
Following properties '[USER.VENDOR]' have been successfully registered.
```

```
prompt> bis list-property-types -P
```

Property Types				
Code	Label	Data Type	Registrator	Registration Date
USER.CELLLINE_NAME	Cell line	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.COLOR	Color	VARCHAR	Darwin, Charles [darwin]	2008-02-19 12:35:03 GMT+01:00
USER.DESCRPTION	Description	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.GENE_SYMBOL	Gene Symbol	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.NUCLEOTIDE_SEQUENCE	Nucleotide Sequence	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.OFFSET	Offset	INTEGER	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.ORG	organism	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.REFSEQ	RefSeq	VARCHAR	System User [system]	2007-12-05 13:33:34 GMT+01:00
USER.SKINCOLOR	Color(1)	CONTROLLEDVOCABULARY (USER.COLOR)	Einstein, Albert [einstein]	2008-02-28 10:10:15 GMT+01:00

```

USER.VENDOR          | Vendor          | VARCHAR          | Doe, John [system] | 2008-04-24 11:08:17 GMT+02:00
(10 rows)

prompt>

```

If you want to see, to which materials, experiments, or samples the properties are assigned, you can call the following methods:

- list-experiment-property-types
- list-plate-property-types
- list-control-layout-property-types
- list-material-property-types

Assign Property Type to Material Type

Now, you are able to assign the new property type `USER.VENDOR` to the material type `CONTROL` with the command `assign-material-property-type`:

```

prompt> bis assign-material-property-type CONTROL USER.VENDOR
Optional property 'USER.VENDOR' successfully assigned to the material type 'CONTROL'.

prompt> bis get-material-type-info -P CONTROL

```

Properties of materials of type CONTROL						
Code	Label	Data Type	M[..]	Description	Registrator	Registration Date
USER.COLOR	Color	VARCHAR	no	Material Color	Darwin, Charles [darwin]	2008-02-19 13:23:59 GMT+01:00
USER.DESCRPTION	Description	VARCHAR	no	A Description	System User [system]	2007-12-19 15:43:20 GMT+01:00
USER.SKINCOLOR	Color(1)	CONTROLLEDVOC[...](USER.COLOR)	no	Color of material	Einstein, Albert [...]	2008-02-28 10:11:21 GMT+01:00
USER.VENDOR	Vendor	VARCHAR	no	Vendor of a material	Doe, John [doe]	2008-04-24 11:14:40 GMT+02:00

```

(4 rows)
prompt>

```

Later on you can change with the same command optional properties to mandatory ones and vice versa. Assignments can be removed by the command `unassign-material-property-type`.

If you want to assigned to certain experiment or sample types a property, you need to call the following methods:

- assign-experiment-property-type
- assign-plate-property-type or assign-sample-property-type
- assign-control-layout-property-type

Register Materials

Registering materials is a prerequisite for registering control layouts and plates. With the command `list-materials` you get a list of already registered materials. For large sets of materials of a certain type (e.g. GENE and OLIGO) it is convenient to reduce the output by the following command line options

- `-b`, `--buffer`: If specified, the output on the console is stopped when the screen is full. By pressing space key or enter key output will be continued. By pressing 'q' output is quited.
- `-l <number of lines>`, `--limit=<number of lines>`: Maximum number of lines to be shown.
- The arguments specified after the material type code restrict the query to those plates whose code matches the specified wild card pattern (* = any string, ? = any character).

In order to register materials you need ADMIN privileges. A tab-separated file like the following has to be prepared before registration:

controls.txt

```
code      user.vendor      user.description
WATER     Stadt Basel     Plain water
TX        VuDu            Toxicase
```

The column `code` is mandatory. Other columns are determined by the assignment of the property types to the material type as discussed above.

The two new materials defined in this example file will be registered for the material type CONTROL by executing the command `register-materials`:

```
prompt> bis register-materials CONTROL controls.txt
Register materials of type 'CONTROL' from 'controls.txt'.
 2 materials of type 'CONTROL' successfully registered.

prompt> bis list-materials -P CONTROL
Code          | Registrator          | Registration Date          | Description          | Color | Vendor
-----|-----|-----|-----|-----|-----|-----
EMPTY         | Doe, John [doe]     | 2008-02-19 13:52:47 GMT+01:00 | empty well          | -     | -
GFP           | System User [system] | 2007-08-24 00:00:00 GMT+02:00 | -                   | -     | -
GREEN         | Doe, John [doe]     | 2008-02-19 13:52:47 GMT+01:00 | my green control    | green | -
SCRAM         | System User [system] | 2007-08-24 00:00:00 GMT+02:00 | -                   | -     | -
TX            | Doe, John [doe]     | 2008-04-24 11:28:01 GMT+02:00 | Toxicase            | -     | VuDu
WATER         | Doe, John [doe]     | 2008-04-24 11:28:01 GMT+02:00 | Plain water         | -     | Stadt Basel
(6 rows)

prompt>
```

In order to register plates you have to register also materials of type COMPOUND or GENE and OLIGO. When an experiment will be registered you have to

specify a material which is called *study object*. Usual a study object is a VIRUS or a BACTERIUM. It might be therefore necessary to register also materials of this type.

Register Control Layouts

As a prerequisite materials of type CONTROL have to be registered because they will be associated with wells in a control layout. A tab-separated file like the following defines a control layout:

TEST_CL.txt

```
code    material
A01     GREEN
A02     EMPTY
B01     GREEN
B02     EMPTY
```

The first column denotes the well codes. It has to be a letter for the row followed by two digits for the column. The second column denotes the corresponding code of a registered material of type CONTROL.

Control layouts can be attached to any plate, be it either a master plate, dilution plate, cell plate or reinfection plate. The attachment can be made when plates are registered to the system.

This control layout is registered by the command `register-control-layout`:

```
prompt> bis register-control-layout -p PLATE_GEOMETRY=384_WELLS_16X24 TEST_CL.txt
Register control layout from 'D:\User\felmer\tmp\openBIS-client\TEST_CL.txt'.
Control layout 'TEST_CL' successfully registered.

prompt> bis list-control-layouts -P
[This table is modified for clarity reasons]
Control Layouts
Code | Type Code | Invalidated | Registrator | Registration Date | Control Layout | Master Plate | Control Layout Master P. | Dilution Plate | Control
Layout Dilution P. | Cell Plate | Control Layout Cell P. | Experiment | Project | Plate Geometry
[...+---+---...]
TEST_CL | CONTROL_LAYOUT | no | [a] | 2008-04-24 11:40:06 GMT+02:00 | - | - | - | - | - | - | - | - | - | 384_WELLS_16X24
(1 rows)

prompt>
```

Note, that

- the name of the file (without extension) is used to define the code of the control layout. The code has to be unique not only among all control layouts but also among all plates.
- you have to specify plate geometry. Available plate geometries can be listed using `get-vocabulary-info PLATE_GEOMETRY` command.

```
prompt> bis get-vocabulary-info PLATE_GEOMETRY -P
Vocabulary Terms
Code          | Registrator          | Registration Date
-----+-----+-----
1536_WELLS_32X48 | System User [system] | 2008-04-18 14:16:00 GMT+02:00
384_WELLS_16X24  | System User [system] | 2008-04-18 14:16:00 GMT+02:00
96_WELLS_8X12   | System User [system] | 2008-04-18 14:16:00 GMT+02:00
(3 rows)
```

Register Plates

Plates are related to each other in a hierarchical way: A plate can have zero or many *derived plates*. The root in this hierarchy is a *master plate*. The whole hierarchy is as follows: master plate > dilution plate > cell plate > reinfection plate. During plate registration this relationship is established.

As a consequence master plates are the first plates to be registered. Registering of a master plate is also different from registering all other types of plates because a registered master plate defines the materials associated with non-control wells for all derived plates.

Register Master Plates

This needs ADMIN privileges. A tab-separated file as the following has to be prepared:

MASTER-PLATE1.txt

```
code      material      material_type
A03       1_A            OLIGO
A04       2_A            OLIGO
B03       12_A           OLIGO
B04       13_A           OLIGO
```

As in the control layout file the first column specifies the wells. The material is specified by the second and third column. Note, that the second column is not enough because the same material code can be used for different material types. Thus, only the combination of material code and material type codes is unique.

First, dilution plates will be registered. A tab-separated file as the following has to be prepared:

dilution-plates.txt

```
code    parent
DP01a   MASTER-PLATE1
DP01b   MASTER-PLATE1
```

These dilution plates are registered by the command `register-dilution-plates`:

```
prompt> bis register-dilution-plates dilution-plates.txt
Register dilution plates from 'D:\User\felmer\tmp\SPRINT~1\OPENBI~1\dilution-plates.txt'.
New dilution plate '[dilutionPlate=DP01a, masterPlate=MASTER-PLATE1]' successfully registered.
New dilution plate '[dilutionPlate=DP01b, masterPlate=MASTER-PLATE1]' successfully registered.

prompt> bis list-plates DILUTION_PLATE -P DP01?
[This table is modified for clarity reasons]
                                Dilution Plates
Code | Type Code | Invalidated | Registrator | Registration Date | Control Layout | Master Plate | Control Layout Master P. | Dilution Plate | Control
Layout Dilution P. | Cell Plate | Control Layout Cell P. | Experiment | Project
[...+-----+-----+-----+...]
DP01A | DILUTION_PLATE | no | [a] | 2008-04-24 11:58:45 GMT+02:00 | - | MASTER-PLATE1 | - | - | - | - | - | - | -
DP01B | DILUTION_PLATE | no | [a] | 2008-04-24 11:58:45 GMT+02:00 | - | MASTER-PLATE1 | - | - | - | - | - | - | -
(2 rows)

prompt> bis get-plate-info -P DP01a
<<<Plate Information for code 'DP01A'>>>
Type Code: DILUTION_PLATE
Registrator Login: a
Registrator Name: -
Registrator Email: -
Registration Date: 2008-04-24 11:58:45 GMT+02:00
Control Layout: -
Master Plate: MASTER-PLATE1
Control Layout Master P.: -
Dilution Plate: -
Control Layout Dilution P.: -
Cell Plate: -
Control Layout Cell P.: -
Generated Plates: -
Experiment: -
Project: -
Consistent: -
Invalidated: no

                                Plate layout
```

```

Gene Id | Gene Symbol | Material Batch | Nucleotide Sequence | Oligo | Well
-----+-----+-----+-----+-----+-----
1      | A1BG       | BATCH7       | DDDBBHDUUDUDDDBDHHBH | 1_A  | A03
2      | A2M        | BATCH7       | UDUBDUBDBBUHHBDUBDHD | 2_A  | A04
12     | SERPINA3   | BATCH7       | UUUBDUUBBUUUUUUBUHD  | 12_A | B03
13     | AADAC      | BATCH7       | HDBDUDUBHUUUDHBDDBDUB | 13_A | B04
(4 rows)
prompt>

```

Registering of cell plates is similar. Again a tab-separated file as the following has to be prepared:

cell-plates.txt

```

Code   Parent
CP01a1 DP01a
CP01a2 DP10a
CP01b1 DP01b

```

These cell plates are registered by the command `register-cell-plates`:

```

prompt> bis register-cell-plates cell-plates.txt
Register cell plates from 'D:\User\felmer\tmp\SPRINT~1\OPENBI~1\cell-plates.txt'.
New cell plate '[cellPlate=CP01a1,dilutionPlate=DP01a]' successfully registered.
New cell plate '[cellPlate=CP01a2,dilutionPlate=DP01a]' successfully registered.
New cell plate '[cellPlate=CP01b1,dilutionPlate=DP01b]' successfully registered.
prompt>

```

For registering reinfection plates see command `register-reinfection-plates`.

Register Experiments

After registration of cell plates (and at least one study object) experiments can be registered.

Register Projects

First, a project has to be chosen or created. All current projects are listed by the command `list-projects`:

```

prompt> bis list-projects -P
Projects

```

```

Code          | Group
-----+-----
DRUGGABLE GENOME | CISD
NEPTUN        | CISD
(2 rows)

prompt>

```

A new project is created by the command `register-project`:

```

prompt> bis register-project example-project
New project 'example-project' has been successfully stored in the database.

prompt> bis list-projects -P
Projects
Code          | Group
-----+-----
DRUGGABLE GENOME | CISD
EXAMPLE-PROJECT | CISD
NEPTUN        | CISD
(3 rows)

prompt>

```

Note: This needs ADMIN privileges.

Register an Experiment

As a minimum two files have to be created in the same folder:

experiments.txt

```

project code   user.description      study_object   study_object_type   cell_plates
example-project experiment1      My first experiment   HIV-1   VIRUS   >cell-plates-for-experiment1.txt

```

and

cell-plates-for-experiment1.txt

```

CP01a1
CP01b1

```

The second file is a list of all cell plates used in `experiment1`. The name of the file is marked in `experiments.txt` by the symbol '>'.

The experiment is registered by the command `register-experiments`. The first parameter should be the code of the experiment type. The allowed experiment types can be obtained by the command `list-experiment-types`.

```
prompt> bis register-experiments SIRNA_HCS experiments.txt
Register experiments from 'D:\User\felmer\tmp\SPRINT~1\OPENBI~1\experiments.txt'.
Experiment '[Experiment=experiment1,Project=example-project]' successfully registered.

prompt> bis list-experiments SIRNA_HCS -P -p example-project
Project Code | Code | Invalidated | Study Object | Registrator | Registration Date | Last Dataset Date | Description
-----+-----+-----+-----+-----+-----+-----+-----
EXAMPLE-PROJECT | EXPERIMENT1 | no | HIV-1 | Doe, John [doe] | 2008-03-20 09:31:13 GMT+01:00 | - | My first experiment
(1 rows)

prompt>
```

Add Documents to Experiments

After an experiment has been registered any kind of document, such as a protocol or a change from the default protocol e.g. can be attached to the experiment by the command `add-experiment-attachment`:

```
prompt> bis add-experiment-attachment example-project experiment1 ..\revision2873.diff
Successfully stored attachment 'D:\User\felmer\tmp\SPRINT~1\OPENBI~1\..\revision2873.diff' for experiment '[Experiment=experimnt1,Project=example-project]'.

prompt> bis get-experiment-info example-project experiment1
<<<Experiment Information for experiment code 'EXPERIMENT1'>>>
Experiment Type: SIRNA_HCS
Registrator Login: u
Registrator Name: The User, U
Registrator Email: u@users.com
Registration Date: 2008-04-24 13:08:12 GMT+02:00
Study Object: HIV-1
Study Object Type: VIRUS
Project Code: EXAMPLE-PROJECT
Project Group: CISD
Description: Experiment without processing instructions

Attachment | Version | Registration Date | Registrator
-----+-----+-----+-----
revision2873.diff | 1 | 2008-04-24 13:16:48 GMT+02:00 | The User, U [u]
(1 rows)
```

```
prompt>
```

An attached document can be downloaded with the command `get-experiment-attachment`:

```
prompt> bis get-experiment-attachment example-project experiment1 revision2873.diff
Successfully retrieved attachment 'D:\User\felmer\tmp\SPRINT~1\OPENBI~1\revision2873.diff' (version: 1) from experiment
'[Experiment=experiment1,Project=example-project]'.
```

```
prompt>
```

Advanced Topics of openBIS

This chapter explains topics which are beyond the scope of a tutorial.

Tab-separated Input and Output

Input

There are various commands needing files in a tab-separated format as input. Such a file contains a table of values. Each row of the table is a line in the file. The values of the different cells in the table are separated by a TAB character. The line before the first row contains the names of each column. They are not case sensitive. The order of the columns can be arbitrary. Tab-separated files are easily created with Excel by just saving a spread sheet as 'Text (Tab delimited)'.

Such tab-separated input files can also be created by other means. The following variations are recognized by openBIS:

- Column headers in first line: Example:

```
code      material      material_type
A03       1_A           OLIGO
A04       2_A           OLIGO
B03       12_A          OLIGO
B04       13_A          OLIGO
```

- Comment section: An arbitrary number of lines before the line with column headers. All lines start with a hash symbol '#'. Example:

```
# Example of a master plate
# used by some tests
code      material      material_type
A03       1_A           OLIGO
A04       2_A           OLIGO
B03       12_A          OLIGO
B04       13_A          OLIGO
```

- Column headers at the end of the comment section: Here the last line of comment section contains the tab-separated column names. The line before contains only a hash symbol '#'. Example:

```
# Example of a master plate
# used by some tests
#
#code    material      material_type
A03      1_A      OLIGO
A04      2_A      OLIGO
B03      12_A     OLIGO
B04      13_A     OLIGO
```

Output

All list commands and some get commands outputs there data in a tab-separated format. The output on the console can be redirected into a file as in the following example:

```
prompt> bis list-material-types > material-types.txt
```

If the type of the file is `.txt` it can be easily import into Excel.

If you want the output more human readable, you can add the option `--pretty-print` or `-P` to the list and get commands. In this case, the output is pretty formatted, as pretty as it is possible on the command line.

Properties

OpenBIS offers its users a mechanism of assigning new property types to the chosen types of materials, experiments, plates and control layouts. In this section it will be described how to manipulate on these properties. For the reason of simplicity the special case of material properties was described, but everything except small differences in command names holds true for all other entities which can have properties.

The system stores information about materials studied in experiments, stored in plate's well etc. During the usage of the system it can turn out, that some new and specific material properties should be stored. E.g. we can specify that all GENE materials should have a SIZE property. From that point it is possible to store a property value for each material.

To get the property types that are currently assigned to a given material type (e.g. OLIGO), enter:

```
prompt> bis get-material-type-info --pretty-print OLIGO
```

The output should like as following:

```
Properties of materials of type OLIGO
Code | Label | Data Type | Manda... | Description | Registrator | Registration Date
```

Code	Description	Data Type	Mandatory	Description	Created By	Created At
USER.DESCRPTION	Description	VARCHAR	no	A Description	System User [...]	2008-[...]GMT+02:00
USER.NUCLEOTIDE_SEQUENCE	Nucleotide Sequence	VARCHAR	yes	A sequence of nucleotides	System User [...]	2008-[...] GMT+02:00
USER.OFFSET	Offset	INTEGER	no	Offset from the start of the sequence	System User [...]	2008-[...]GMT+02:00

(3 rows)

It means that each OLIGO material has besides the code and inhibitor code three properties: description, nucleotide sequence and the offset. Value of each property for each material is displayed together with other information when `list-materials` command is executed.

Registering materials with properties

When new materials are registered in the system, values for their properties should be specified in the file together with the material codes and other fields. Values for a particular property should be placed in one column. The name of the column should be the same as the property code displayed by the `get-material-type-info` command (see 'Code' column in the listing above). If the property is mandatory then its value has to be specified for all materials of the given type. In the example table above we see, that for OLIGO materials the nucleotide sequence property is mandatory and all others are optional.

Displaying existing property types

If we want to assign a new property to a chosen type of material, first we have to make sure, that the appropriate property type is defined. To get all available property types and their description enter:

```
prompt> bis list-property-types --pretty-print
```

You should get something like:

Code	Label	Data Type	Registrator	Registration Date
USER.DESCRPTION	Description	VARCHAR	System User [system]	2008-04-18 14:16:00 GMT+02:00
USER.GENE_SYMBOL	Gene Symbol	VARCHAR	System User [system]	2008-04-18 14:16:00 GMT+02:00
USER.NUCLEOTIDE_SEQUENCE	Nucleotide Sequence	VARCHAR	System User [system]	2008-04-18 14:16:00 GMT+02:00
USER.OFFSET	Offset	INTEGER	System User [system]	2008-04-18 14:16:00 GMT+02:00
USER.REFSEQ	RefSeq	VARCHAR	System User [system]	2008-04-18 14:16:00 GMT+02:00

(5 rows)

The 'Data Type' column explains what kind of values a given property can store. Following data types are currently supported:

1. VARCHAR: text, cannot be longer than 1024 characters.
2. INTEGER: integer number. Can be positive or negative (..., -1, -2, -3, 0, 1, 2, 3, ...).
3. REAL: a real number, such as 2.4871773339 or -5.0.
4. BOOLEAN: value can be true or false
5. TIMESTAMP: date and time

The command `list-property-types` shows all available property types.

If you want to see, to which Material, Experiment or Sample the properties are assigned, you can call the following methods:

- `list-experiment-property-types`
- `list-plate-property-types`
- `list-control-layout-property-types`
- `list-material-property-types`

Defining a new property type

If the property type which we want to assign to a material type does not yet exist, it can be defined using the `register-property-types` command. Note that an Administrator role is required to do that. In the example below 3 new property types are registered:

```
prompt> bis register-property-types examplePropertyTypes.txt
```

where `examplePropertyTypes.txt` is the path to a tab separated file composed of exactly 4 columns:

1. `code` - the code of the new property type, used when new materials are defined
2. `description` - text which can be helpful later on to determine what is this property useful for,
3. `label` - used when displaying property values,
4. `dataTypeCode` - what kind of data a property should store (e.g. text or numbers). Available values are VARCHAR, INTEGER, REAL, BOOLEAN and TIMESTAMP.

The file which is given as a parameter could look like that:

code	description	label	data_type
USER.EYE COLOR	The color of the eyes	Eye color	VARCHAR
USER.SIZE	The size of the object	Size	INTEGER
USER.VOLUME	The volume of this person	Volume	REAL

```
USER.IS_VALID  Can the material be used? Valid?    BOOLEAN
USER.PURCHASE_DATE  Date of purchase    Purchased  TIMESTAMP
```

Assigning an optional property

It is possible to assign a new property type to a given material type using the command `assign-material-property-type` (only for users having ADMIN role). To assign SIZE property to all materials of type GENE, enter:

```
prompt> bis assign-material-property-type GENE USER.SIZE
```

Of course, property type with a given name (here SIZE) must already be defined. From this point it is possible to specify SIZE value for each gene during gene registration. By default the assigned property is optional, so for some materials the value of the property can be unspecified.

Assigning a mandatory property

By using `assign-material-property-type` command with `-m` parameter a mandatory property can be assigned:

```
prompt> bis assign-material-property-type GENE USER.SIZE -m
```

Assigning a mandatory property to materials of some type causes that the value of the property has to be specified for all the materials of the chosen type. That is why the command above works only if no GENE materials have been defined in the system till that point. If this is not the case, then the file with values for all currently existing genes have to be provided:

```
prompt> bis assign-material-property-type GENE USER.SIZE -m -f gene-size-values.txt
```

The file has to contain one row with two columns for each gene material. The first column specifies material code and the second is the value of the property for that material.

```
code  value
1     13
2     98
3     12
```

To check for which material codes the value of the property has to be specified, execute the command without specifying the file after `-f` option. All the codes will be displayed on the console. To save all those codes in the file, use output redirection:

```
prompt> bis assign-material-property-type GENE USER.SIZE -m > missing-gene-codes.txt
```

Changing a 'mandatory' flag for a property

The `assign-material-property-type` command can be also used to change the 'mandatory' flag of properties, which were already assigned to material types. If the property is mandatory, it can be made optional by executing the command again, but without `-m` parameter.

```
prompt> bis assign-material-property-type GENE USER.SIZE
```

Making the optional property mandatory may require specifying all missing property values in the file:

```
prompt> bis assign-material-property-type GENE USER.SIZE -m -f missing-gene-size-values.txt
```

Removing a property

To declare that a given property type is no longer applicable to a chosen material type, enter the command `unassign-material-property-type` and specify material type and property code:

```
prompt> bis unassign-material-property-type GENE USER.SIZE
```

If the values for a property which is about to be removed were already specified for some materials, then after user's confirmation all those values will be deleted too.

openBIS Commands

In this section all commands are listed (in alphabetical order) and described. By just typing `bis` (or `bis.sh` for Linux and MacOS) all commands are listed.

The following options are applicable for all commands and therefore not mentioned in the descriptions of the commands below:

- `-h, --help`: Shows a help text with a brief description of all options and arguments.
- `-s <base URL>, --server-base-url=<base URL>`: The base URL of the openBIS server. If not specified the URL from the file `.openBIS-default` will be used.
- Browsing commands
 - `get-control-layout-info`
 - `get-control-layout-type-info`
 - `get-experiment-attachment`
 - `get-experiment-info`
 - `get-experiment-type-info`
 - `get-material-type-info`
 - `get-plate-info` (alias for `get-sample-info`)
 - `get-plate-locations`
 - `get-plate-type-info` (alias for `get-sample-type-info`)
 - `get-sample-info`
 - `get-sample-type-info`
 - `get-vocabulary-info`
 - `list-contacts`
 - `list-experiment-attachments`
 - `list-experiment-datasets`
 - `list-experiment-plates`
 - `list-experiment-property-types`
 - `list-experiment-samples`
 - `list-experiment-types`
 - `list-experiments`
 - `list-material-property-types`
 - `list-material-types`
 - `list-materials`
 - `list-plate-types` (alias for `list-sample-types`)
 - `list-plates`
 - `list-samples`
 - `list-sample-types`
 - `list-processing-instructions`
 - `list-projects`
 - `list-property-types`
 - `list-plate-property-types`
 - `list-control-layout-property-types`

- list-control-layouts
- list-vocabularies
- login
- logout
- Commands for Users and Administrators
 - add-experiment-attachment
 - register-cell-plates
 - register-control-layout
 - register-dilution-plates
 - register-samples
 - register-experiments
 - register-reinfection-plates
 - set-experiment-property
 - set-material-property
 - set-sample-property
- Commands for Administrators only
 - assign-control-layout-property-type
 - assign-experiment-property-type
 - assign-material-property-type
 - assign-plate-property-type
 - assign-sample-property-type
 - invalidate-experiment
 - invalidate-plates (alias for invalidate-samples)
 - invalidate-samples
 - register-experiment-type
 - register-master-plate
 - register-materials
 - register-material-types
 - register-project
 - register-property-types
 - register-sample-type
 - register-vocabulary
 - unassign-control-layout-property-type
 - unassign-experiment-property-type
 - unassign-material-property-type
 - unassign-plate-property-type
 - unassign-sample-property-type

Browsing commands

get-control-layout-info

Description: Shows the code of the material of type CONTROL for each well (specified in the format <row letter><two colum digits>) of the control layout.

Usage:

```
prompt> bis get-control-layout-info [--pretty-print] <control layout code>
```

Options:

- `-P`, `--pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<control layout code>`: Code of the control layout. The command `list-control-layouts` lists all available values.

get-control-layout-type-info

Description: Lists the property types assigned to control layouts.

Usage:

```
prompt> bis get-control-layout-type-info [--pretty-print]
```

Options:

- `-P`, `--pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

get-data

Description: Downloads either parts of or complete data sets from openBIS . When a file is specified in the data set, by default the content of the file will be written to standard output. If option `-r` is specified, the file will be written to the local harddisk instead. When a directory is specified, the listing of the directory will be written to standard output. If option `-r` is specified, the directory will be recursively downloaded.

Usage:

```
prompt> bis get-data <dataset-code> [<path-in-dataset>]
```

Options:

- `-d <destination-path>`, `--directory=<destination-path>`: Directory where the data should be saved. Valid only with recursive download option. If not specified, the current directory will be used.
- `-r`, `--recursive`: Downloads the specified data and saves them to disc. If a directory is being downloaded, the content of all subdirectories will be fetched recursively, too.

Parameter:

- `<dataset-code>`: The code of the data set to get from the server.
- `<path-in-dataset>`: The relative path (can be either a file or a directory) in the data set to download. If not specified, the top-level directory will be listed / downloaded.

get-experiment-attachment

Description: Downloads a specified file which has been attached to a specified experiment by the command `add-experiment-attachment`.

Usage:

```
prompt> bis get-experiment-attachment [-v <version number>] <project code> <experiment code> <file name>
```

Options:

- `-v <version number>`, `--attachmentVersion=<version number>`: Version of the requested file. Has to be a number greater or equals 1. Without this option the latest version will be downloaded.

Parameter:

- `<project code>`: Code of the project to which the experiment belongs.
- `<experiment code>`: Code of the experiment. Available experiments can be listed by the command `list-experiments`.
- `<file name>`: Name of the file to be downloaded.

get-experiment-info

Description: Gets basic information about a specified experiments.

Usage:

```
prompt> bis get-experiment-info [--pretty-print] <project code> <experiment code>
```

Other detailed information about the experiment can be obtained by commands:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-datasets`
- `list-experiment-plates`

Options:

- `-P`, `--pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<project code>`: Code of the project to which the experiments belong.
- `<experiment code>`: Codes of the experiments. Exactly one experiment has to be specified. Available experiments can be listed by the command `list-experiments`.

get-experiment-type-info

Description: Lists the property types assigned to a specified experiment type.

Usage:

```
prompt> bis get-experiment-type-info [--pretty-print] <experiment type code>
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<experiment type code>`: The experiment. The command `list-experiments` lists all available values.

get-material-type-info

Description: Lists the property types assigned to a specified material type.

Usage:

```
prompt> bis get-material-type-info [--pretty-print] <material type code>
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<material type code>`: Code of the material type. The command `list-material-types` lists all available values.

get-sample-info

Description: Gets detailed information about a plate.

Usage:

```
prompt> bis get-sample-info [-b] [--pretty-print] <sample code>
```

Options:

- `-b, --buffer`: If specified, the output on the console is stopped when the screen is full. By pressing space key or enter key output will be continued. By pressing 'q' output is quited.
- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.
- `<sample code>`: Code of the sample to be shown.

Alias name: `get-plate-info`

get-plate-locations

Description: Lists for a specified gene its locations in all plates for all valid experiments. The set of experiments can be restricted by various options.

Usage:

```
prompt> bis get-plate-locations [-a] [-p <project code>] [-e <experiment code>] [-i] [-o <study object code>] [-t [<from>]:<until>]] <gene-symbol or id>
```

Options:

- `-a, --show-also-invalid`: Also locations of invalid plates are shown if this flag is specified.
- `-i, --gene-id`: Parameter `<gene-symbol or id>` is interpreted as gene id if this flag is specified.
- `-p <project code>, --project=<project code>`: Code of a project. This restricts the query. Available projects can be listed by the command `list-projects`.
- `-e <experiment code>, --experiment=<experiment code>`: Code of an experiment. Will be ignored if option `-p` is not also specified. This restricts the query to one specific experiment. Available experiments can be listed by the command `list-experiments`.
- `-o <study object code>, --study-object=<material code>`: Material code of the object to be studied. This restricts the query.
- `-t <time interval>, --time-interval=<time interval>`: A query restriction on the time interval. Only those experiments are taken into account which have an overlap of the specified time interval with the time interval defined by the experiment registration date and the registration date of the last registered data set.

Parameter:

- `<gene-symbol or id>`: The gene symbol. Because the gene symbol is not unique the gene id can be used if the option `-i` is specified.

get-sample-type-info

Description: Lists the property types assigned to a specified sample type.

Usage:

```
prompt> bis get-sample-type-info [--pretty-print] <sample type code>
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<sample type code>`: The sample type. The command `list-sample-types` lists all available values.

Alias name: `get-plate-type-info`

get-vocabulary-info

Description: Lists all terms in a given controlled vocabulary set. To see available vocabulary sets, use `list-vocabularies` command.

Usage:

```
prompt> bis get-vocabulary-info [--pretty-print] <vocabulary-code>
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<vocabulary-code>`: Code of the controlled vocabulary set.

list-contacts

Description: Lists all persons who used the system.

Usage:

```
prompt> bis list-contacts [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-control-layout-property-types

Description: Lists all property types for control layout and also show the assignment, which property type is used for which assignment and if the property type is mandatory.

Usage:

```
prompt> bis list-control-layout-property-types [--pretty-print]
```

If you want to see the other assignment:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-datasets`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-control-layouts

Description: Lists all control layouts.

Usage:

```
prompt> bis list-control-layouts [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-experiment-attachments

Description: Prints information about all the documents attached to a specified experiment. Additionally basic information about the experiment (as in `get-experiment-info`) are listed.

Usage:

```
prompt> bis list-experiment-attachments [--pretty-print] <project code>
<experiment code>
```

Other detailed information about the experiment can be obtained by commands:

- `list-processing-instructions`
- `list-experiment-datasets`
- `list-experiment-plates`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<project code>`: Code of the project to which the experiments belong.
- `<experiment code>`: Codes of the experiments. Exactly one experiment has to be specified. Available experiments can be listed by the command `list-experiments`.

list-experiment-datasets

Description: Prints information about all datasets produced in a specified experiment. Additionally basic information about the experiment (as in `get-experiment-info`) are listed.

Usage:

```
prompt> bis list-experiment-datasets [--pretty-print] <project code> <experiment
code>
```

Other detailed information about the experiment can be obtained by commands:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-plates`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<project code>`: Code of the project to which the experiments belong.
- `<experiment code>`: Codes of the experiments. Exactly one experiment has to be specified. Available experiments can be listed by the command `list-experiments`.

list-experiment-plates

Description: Prints information about all screening plates that are connected to the specified experiment. Additionally basic information about the experiment (as in `get-experiment-info`) is listed. This command makes only sense for screening experiments. Use `list-experiment-samples` for non-screening experiments instead.

Usage:

```
prompt> bis list-experiment-plates [--pretty-print] <project code> <experiment code>
```

Other detailed information about the experiment can be obtained by commands:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-datasets`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<project code>`: Code of the project to which the experiments belong.
- `<experiment code>`: Codes of the experiments. Exactly one experiment has to be specified. Available experiments can be listed by the command `list-experiments`.

list-experiment-property-types

Description: Lists all property types for experiment and also show the assignment, which property type is used for which assignment and if the property type is mandatory.

Usage:

```
prompt> bis list-experiment-property-types [--pretty-print]
```

If you want to see the other assignment:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-datasets`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-experiment-samples

Description: Prints information about all samples that are connected to the specified experiment. Additionally basic information about the experiment (as in `get-experiment-info`) is listed.

Usage:

```
prompt> bis list-experiment-samples [--pretty-print] <project code> <experiment code>
```

Other detailed information about the experiment can be obtained by commands:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-datasets`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<project code>`: Code of the project to which the experiments belong.
- `<experiment code>`: Codes of the experiments. Exactly one experiment has to be specified. Available experiments can be listed by the command `list-experiments`.

list-experiment-types

Description: Lists all experiment types.

Usage:

```
prompt> bis list-experiment-types [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-experiments

Description: Lists all valid experiments. The set of experiments can be restricted by various options.

Usage:

```
prompt> bis list-experiments [-a] [--pretty-print] [-p <project code>] [-o <study object code>] [-t [<from>]:<until>]] <experiment type code>
```

Options:

- `-a, --show-also-invalid`: Also invalid experiments are shown if this

flag is specified.

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.
- `-p <project code>, --project=<project code>`: Code of a project. This restricts the query. Available projects can be listed by the command `list-projects`.
- `-o <study object code>, --study-object=<material code>`: Material code of the object to be studied. This restricts the query.
- `-t <time interval>, --time-interval=<time interval>`: A query restriction on the time interval. Only those experiments are taken into account which have an overlap of the specified time interval with the time interval defined by the experiment registration date and the registration date of the last registered data set.

Parameter: `<experiment type code>`: Code of the experiment type. The command `list-experiment-types` lists all available values.

list-file-format-types

Description: Lists all file format types.

Usage:

```
prompt> bis list-file-format-types [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-materials

Description: Lists all materials of a specified type.

Usage:

```
prompt> bis list-materials [-b] [--pretty-print] [-l <number of lines>] <material type code> ["<pattern>" ...]
```

Options:

- `-b, --buffer`: If specified, the output on the console is stopped when the screen is full. By pressing space key or enter key output will be continued. By pressing 'q' output is quited.
- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.
- `-l <number of lines>, --limit=<number of lines>`: Maximum number of lines to be shown.
- `["<pattern>" ...]`: Restricts the query to those materials whose code matches the specified wild card pattern (* = any string, ? = any character). Pattern should be placed inside the quotation marks.

Parameter:

- `<material type code>`: Code of the material type. The command `list-material-types` lists all available values.

list-material-types

Description: Lists all material types.

Usage:

```
prompt> bis list-material-types [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-material-property-types

Description: Lists all property types for material and also show the assignment, which property type is used for which assignment and if the property type is mandatory.

Usage:

```
prompt> bis list-material-property-types [--pretty-print]
```

If you want to see the other assignment:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-datasets`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-observable-types

Description: Lists all observable types.

Usage:

```
prompt> bis list-observable-types [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-plates

Description: Lists all plates of a specified type. Various command line options may restrict or expand the list.

Usage:

```
prompt> bis list-plates [-a] [-b] [--pretty-print] [-l <number of lines>] [-n]
<plate type code> ["<pattern>" ...]
```

Options:

- `-a`, `--show-also-invalid`: Also invalid plates are shown if this flag is specified.
- `-b`, `--buffer`: If specified, the output on the console is stopped when the screen is full. By pressing space key or enter key output will be continued. By pressing 'q' output is quited.
- `-P`, `--pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.
- `-l <number of lines>`, `--limit=<number of lines>`: Maximum number of lines to be shown.
- `-n`, `--no-experiment`: Only plates registered to an experiment are shown.
- `["<pattern>" ...]`: Restricts the query to those plates whose code matches the specified wild card pattern (* = any string, ? = any character). Pattern should be placed inside the quotation marks.

Parameter: `<plate type code>`: Code of the plate type. The command `list-plate-types` lists all available values.

list-processing-instructions

Description: Prints information about all processing instructions in a specified experiment. Additionally basic information about the experiment (as in `get-experiment-info`) are listed.

Usage:

```
prompt> bis list-processing-instructions <project code> <experiment code>
```

Other detailed information about the experiment can be obtained by commands:

- `list-experiment-attachments`
- `list-processing-instructions`
- `list-experiment-datasets`

Options:

- `-P`, `--pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<project code>`: Code of the project to which the experiments belong.
- `<experiment code>`: Codes of the experiments. Exactly one experiment

has to be specified. Available experiments can be listed by the command `list-experiments`.

list-projects

Description: Lists all projects.

Usage:

```
prompt> bis list-project [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-property-types

Description: Lists all property types.

Usage:

```
prompt> bis list-property-types [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

list-samples

Description: Lists all samples of a specified type. Various command line options may restrict or expand the list.

Usage:

```
prompt> bis list-samples [-a] [-b] [--pretty-print] [-l <number of lines>] [-n]
<sample type code> ["<pattern>" ...]
```

Options:

- `-a, --show-also-invalid`: Also invalid plates are shown if this flag is specified.
- `-b, --buffer`: If specified, the output on the console is stopped when the screen is full. By pressing space key or enter key output will be continued. By pressing 'q' output is quited.
- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.
- `-l <number of lines>, --limit=<number of lines>`: Maximum number of lines to be shown.
- `-n, --no-experiment`: Only plates registered to an experiment are shown.

- ["<pattern>" ...]: Restricts the query to those plates whose code matches the specified wild card pattern (* = any string, ? = any character). Pattern should be placed inside the quotation marks.

Parameter: <sample type code>: Code of the sample type. The command `list-sample-types` lists all available values.

list-sample-types

Description: Lists all sample types.

Usage:

```
prompt> bis list-sample-types [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

Alias name: `list-plate-types`

list-sample-property-types

Description: Lists all property types for samples and also show the assignment, which property type is used for which assignment and if the property type is mandatory.

Usage:

```
prompt> bis list-sample-property-types [--pretty-print]
```

If you want to see property assignment for other entities:

- `list-experiment-property-types`
- `list-material-property-types`

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

Alias name: `list-plate-property-types`

list-vocabularies

Description: Lists all available vocabularies. A vocabulary is a collection of terms. This set can be used as a data type for a property type. To see terms available in a given vocabulary set, use `get-vocabulary-info` command.

Usage:

```
prompt> bis list-vocabularies [--pretty-print]
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter: No parameters.

login

Description: Authenticates the specified user and establishes a connection to the openBIS server. A connection will be automatically closed after some idle time.

An authenticated user has a role which may restrict the set of commands he or she is allowed to execute.

Usage:

```
prompt> bis login [-u <login name>] [-p <password>]
```

Options:

- `-u <login name>, --username=<login name>`: The login name of the user to be authenticated. If not specified the user will be asked.
- `-p <password>, --password=<password>`: The password of the user to be authenticated. If not specified the user will be asked. **This option should only be used in scripts calling this command.**

Blank option value (uniquely composed of whitespace, empty ("")) are considered by the system as *not provided* and will throw an error.

Parameter: No parameters.

logout

Description: Closes the connection to the openBIS server.

Usage:

```
prompt> bis logout
```

Options: No additional options.

Parameter: No parameters.

search

Description: Searches for experiments, samples and materials that matches a given search term. The search will first look for property values, then for codes, then for registrators and finally for registration dates (in the format *2008-11-18*).

Usage:

```
prompt> bis search <search-term>
```

Options:

- `-P, --pretty-print`: Shows the data in a pretty printed format which is more human readable than the tab-separated one.

Parameter:

- `<search-term>`: The term to search for in properties, codes, registrators and registration dates.

Commands for Users and Administrators

add-experiment-attachment

Description: Uploads and attaches an arbitrary file to a specified experiment. The file name is used to identify the attachment and to download it with command `get-experiment-attachment`.

A new version can be uploaded by this command. All versions are available for downloading.

Usage:

```
prompt> bis add-experiment-attachment <project code> <experiment code> <file path>
```

Options: no additional options.

Parameter:

- `<project code>`: Code of the project to which the experiment belongs.
- `<experiment code>`: Code of the experiment. Available experiments can be listed by the command `list-experiments`.
- `<file path>`: Path to the file to be uploaded.

register-cell-plates

Description: Registers all cell plates specified in a file. For each cell plate a corresponding dilution plate has to be specified.

Usage:

```
prompt> bis register-cell-plates [-c <control layout code>] <cell plate file>
```

Options:

- `-c <control layout code>`, `--control-layout=<control layout code>`: Control layout code which will be used for all plates whose control layout has not been specified in the plate file.

Parameter:

- `<cell plate file>`: A tab-separated file with at least two columns: code and parent. The first column contains unique and currently not registered cell plate codes (maximum length: 40 characters). The second column contains codes of already registered dilution plates (registered by the command `register-dilution-plates`). In an optional column `control_layout` individual control layout codes (registered by the command `register-control-layout`) can be specified for chosen cell plates. `exampleCellPlates.txt` or `exampleCellPlatesWithControl.txt` can serve

as templates. Additional columns may or must appear if properties have been assigned to cell plates.

register-control-layout

Description: Registers a control layout specified in a file. This command specifies for certain wells a certain material of type CONTROL.

Note:

- The file name without the extension serves as the code of the control layout to be registered.
- Property PLATE_GEOMETRY is mandatory for control layouts and must be specified. Available plate geometries can be listed using `get-vocabulary-info PLATE_GEOMETRY` command.

Usage:

```
prompt> bis register-control-layout [-p <property code>=<property value>] [-f  
<properties file>] <control layout file>
```

Options:

- `-p <property code>=<property value>`, `--property=<property code>=<property value>`: Setting the value of the property named `<property code>`. This can only be used for setting one property. If you want or have to set more than one property, use the `-f` option with a properties file.
- `-f <properties file>`, `--properties-file=<properties file>`: A tab-separated file with two columns (named `code` and `value`) for all properties to be set.

Parameter:

- `<control layout file>`: A tab-separated file with at two columns: `code` and `materialCode`. The first column contains well codes in the format `<row letter><two colum digits>`. The second column contains codes of already registered materials of type CONTROL (registered by the command `register-materials`). `CL1.txt` can serve as template. As the file name (without the extension) specifies the control layout code, only valid characters can be used (letters, numbers and underscore).

register-dilution-plates

Description: Registers all dilution plates specified in a file. For each dilution plate a corresponding master plate has to be specified. Optional a control layout can be associated.

Usage:

```
prompt> bis register-dilution-plates [-c <control layout code>] [-c <control  
layout code>] <dilution plate file>
```

Options:

- `-c <control layout code>`, `--control-layout=<control layout code>`: Control layout code which will be used for all plates whose control layout has not been

specified in the plate file.

Parameter:

- `<dilution plate file>`: A tab-separated file with at least two columns: `Dilution Plate` and `Master Plate`. The first column contains unique and currently not registered dilution plate codes (maximum length: 40 characters). The second column contains codes of already registered master plates (registered by the command `register-master-plate`). In an optional column `Control Layout` individual control layout codes (registered by the command `register-control-layout`) can be specified for chosen dilution plates. `exampleDilutionPlates.txt` or `exampleDilutionPlatesWithControl.txt` can serve as templates. Additional columns may or must appear if properties have been assigned to dilution plates.

register-experiments

Description: Registers one or more experiments as specified in the file.

Usage:

```
prompt> bis register-experiments [-d <root directory>] <experiment-type-code>
<experiment file>
```

Options:

- `-d <root directory>`, `--root-dir=<root directory>`: Root directory of `<experiment file>` and all files referred inside an experiment file.

Parameter:

- `<experiment-type-code>`: Code of an existing experiment type. The allowed experiment types can be obtained by the command `list-experiment-types`.
- `<experiment file>`: File specifying the experiments to be registered. A tab-separated experiment file contains the following columns (order is irrelevant):

Column name	Mandatory?	Description
<code>project</code>	yes	Code of a registered project.
<code>code</code>	yes	Experiment code which has to be unique in the specified project. It has to be no longer than 40 characters and cannot contain any dashes.
<code>study_object</code>	yes	Code of a registered material of the type specified by <code>study_object_type</code> .
<code>study_object_type</code>	yes	Code of a registered material type.

Column name	Mandatory?	Description
cell_plates	yes/no	File of cell plates associated with this experiment. The file path has to be relative to the above-mentioned root directory. The path has to be prefixed by '>'. The file has no header and contains one cell plate code per line. This column is optional if the workflow-code is plates-on-demand (i.e. old IMSB workflow). cellPlates.txt is an example.
control_layout	no/yes	Code of a registered control layout. This is a mandatory column if the workflow-code is plates-on-demand. Otherwise this column is not allowed.
user.description	no	A brief description of the purpose of the experiment to be registered.
processing_instructions	no	Processing instructions for the ETL Server. The instructions are specified in a file whose path is relative to the root directory. The path has to be prefixed by '>'. A processing instruction file is a tab-separated file with the mandatory columns procedure_type and path. The procedure type code has to be either DATA_ACQUISITION or IMAGE_ANALYSIS. Optional columns are description and parameters. The last one denotes the path (relative to the above-mentioned root directory and with prefix '>') of the processing parameters which will be uploaded. exampleProcessingInstructions.txt can serve as a template.

exampleExperiments.txt can serve as a template if the workflow-code is plates-on-demand. Otherwise exampleExperimentsWithCellPlates.txt can serve as a template.

register-reinfection-plates

Description: Registers reinfection plates specified in a file. For each reinfection plate a corresponding cell plate has to be specified. Optionally a control layout can be associated.

Usage:

```
prompt> bis register-reinfection-plates [-c <control layout code>] <reinfection
plate file>
```

Options:

- -c <control layout code>, --control-layout=<control layout code>: Code of the control layout which will be used for all reinfection plates whose control

layout has not been specified in the reinfection plate file.

Parameter:

- `<reinfection plate file>`: A tab-separated file with at least two columns: `code` and `parent`. The first column contains unique and currently not registered reinfection plate codes (maximum length: 40 characters). The second column contains codes of already registered cell plates (registered by the command `register-cell-plates`). In an optional column `control_layout` individual control layout codes (registered by the command `register-control-layout`) can be specified for chosen cell plates. `exampleReinfectionPlates.txt` or `exampleReinfectionPlatesWithControl.txt` can serve as templates. Additional columns may or must appear if properties have been assigned to reinfection plates.

register-sample

Description: Registers all samples specified in a file. For each sample a corresponding parent sample can be specified. Mandatory properties for the according sample types have to be, optional properties can be specified.

Usage:

```
prompt> bis register-cell-plates [-c <control layout code>] <cell plate file>
```

Options:

- `-c <control layout code>`, `--control-layout=<control layout code>`: Control layout code which will be used for all plates whose control layout has not been specified in the plate file.

Parameter:

- `<cell plate file>`: A tab-separated file with at least one column which is `code`. It has to contain unique and currently not registered samples codes (maximum length: 40 characters). A second column with name `parent` can be specified optionally. This column contains codes of already registered samples (registered by the command `register-sample` before). `exampleMassSpecSamples.txt` can serve as a template. Additional columns may or must appear if properties have been assigned to cell plates.

set-experiment-property

Description: Sets the value for an experiment property.

Usage:

```
prompt> bis set-experiment-property <project code> <experiment code> <property type code>[=| ]<property value>
```

Options: -

Parameter:

- `<project code>`: The project where the experiment is located in
- `<experiment code>`: The code of the experiment to set the value for
- `<property type code>`: The code of the property type to set the value for
- `<property value>`: The value of the property to set

set-material-property

Description: Sets the value for an material property.

Usage:

```
prompt> bis set-material-property <material type code> <material code> <property type code>[=| ]<property value>"
```

Options: -

Parameter:

- `<material type code>`: The code of the material type
- `<experiment code>`: The code of the material to set the value for; note that material codes are only unique together with the material type code
- `<property type code>`: The code of the property type to set the value for
- `<property value>`: The value of the property to set

set-sample-property

Description: Sets the value for a sample property.

Usage:

```
prompt> bis set-sample-property <sample code> <property type code>[=| ]<property value>"
```

Options: -

Parameter:

- `<sample code>`: The code of the sample to set the value for
- `<property type code>`: The code of the property type to set the value for
- `<property value>`: The value of the property to set

Commands for Administrators only

assign-control-layout-property-type

Description: Assigns a property type to a control layout. The assigned property type

can be optional or mandatory. This can be changed by executing this command again.

If an optional property type is changed to a mandatory one it might be necessary to specify a file with values for this property. This tab-separated file has to provide a value for all control layouts which do not have a value for the property which had become mandatory.

Usage:

```
prompt> bis assign-control-layout-property-type [-f <file path>] [-g <global default value>] [-m[=<mandatory flag>]] <property type code>
```

Options:

- `-f <file path>`, `--load-values=<file path>`: A tab-separated text file (specified by `<file path>`) with two columns: code (here control layout code) and value.
- `-g <global default value>`, `--global=<global default value>`: A global default value for entities that are not specified in `<file path>`.
- `-m[=<mandatory flag>]`, `--mandatory[=<mandatory flag>]`: If `<mandatory flag>` is true or missing the assign property type will be a mandatory one. If this option is not specified it will be optional.

Parameter:

- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

assign-experiment-property-type

Description: Assigns a property type to an experiment type. The assigned property type can be optional or mandatory. This can be changed by executing this command again.

If an optional property type is changed to a mandatory one it might be necessary to specify a file with values for this property. This tab-separated file has to provide a value for all experiments of all projects which do not have a value for the property which had become mandatory.

Usage:

```
prompt> bis assign-experiment-property-type [-f <file path>] [-g <global default value>] [-m[=<mandatory flag>]] <experiment type code> <property type code>
```

Options:

- `-f <file path>`, `--load-values=<file path>`: A tab-separated text file (specified by `<file path>`) with three columns: code (here experiment code), project and value.
- `-g <global default value>`, `--global=<global default value>`: A global default value for entities that are not specified in `<file path>`.
- `-m[=<mandatory flag>]`, `--mandatory[=<mandatory flag>]`

flag>]: If <mandatory flag> is true or missing the assign property type will be a mandatory one. If this option is not specified it will be optional.

Parameter:

- <experiment type code>: Code of the experiment type. The command `list-experiment-types` lists all available values.
- <property type code>: Code of the property type. The command `list-property-types` lists all available values.

assign-material-property-type

Description: Assigns a property type to a material type. The assigned property type can be optional or mandatory. This can be changed by executing this command again.

If an optional property type is changed to a mandatory one it might be necessary to specify a file with values for this property. This tab-separated file has to provide a value for all materials which do not have a value for the property which had become mandatory.

Usage:

```
prompt> bis assign-material-property-type [-f <file path>] [-g <global default value>] [-m[=<mandatory flag>]] <material type code> <property type code>
```

Options:

- `-f <file path>`, `--load-values=<file path>`: A tab-separated text file (specified by <file path> with two columns: code (here material code) and value.
- `-g <global default value>`, `--global=<global default value>`: A global default value for entities that are not specified in <file path>.
- `-m[=<mandatory flag>]`, `--mandatory[=<mandatory flag>]`: If <mandatory flag> is true or missing the assign property type will be a mandatory one. If this option is not specified it will be optional.

Parameter:

- <material type code>: Code of the material type. The command `list-material-types` lists all available values.
- <property type code>: Code of the property type. The command `list-property-types` lists all available values.

assign-plate-property-type

Description: Assigns a property type to a plate type. The assigned property type can be optional or mandatory. This can be changed by executing this command again.

If an optional property type is changed to a mandatory one it might be necessary to specify a file with values for this property. This tab-separated file has to provide a value for all plates which do not have a value for the property which had become

mandatory.

Usage:

```
prompt> bis assign-plate-property-type [-f <file path>] [-g <global default value>] [-m[=<mandatory flag>]] <plate type code> <property type code>
```

Options:

- `-f <file path>`, `--load-values=<file path>`: A tab-separated text file (specified by `<file path>` with two columns: code (here plate code) and value.
- `-g <global default value>`, `--global=<global default value>`: A global default value for entities that are not specified in `<file path>`.
- `-m[=<mandatory flag>]`, `--mandatory[=<mandatory flag>]`: If `<mandatory flag>` is true or missing the assign property type will be a mandatory one. If this option is not specified it will be optional.

Parameter:

- `<plate type code>`: Code of the sample type. The command `list-plates-types` lists all available values.
- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

assign-sample-property-type

Description: Assigns a property type to a sample type. The assigned property type can be optional or mandatory. This can be changed by executing this command again.

If an optional property type is changed to a mandatory one it might be necessary to specify a file with values for this property. This tab-separated file has to provide a value for all plates which do not have a value for the property which had become mandatory.

Usage:

```
prompt> bis assign-sample-property-type [-f <file path>] [-g <global default value>] [-m[=<mandatory flag>]] <sample type code> <property type code>
```

Options:

- `-f <file path>`, `--load-values=<file path>`: A tab-separated text file (specified by `<file path>` with two columns: code (here plate code) and value.
- `-g <global default value>`, `--global=<global default value>`: A global default value for entities that are not specified in `<file path>`.
- `-m[=<mandatory flag>]`, `--mandatory[=<mandatory flag>]`: If `<mandatory flag>` is true or missing the assign property type will be a mandatory one. If this option is not specified it will be optional.

Parameter:

- `<sample type code>`: Code of the sample type. The command `list-sample-types` lists all available values.
- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

invalidate-experiment

Description: Invalidates a specified experiment. After invalidation the plates which were used in the invalidated experiment can be reused in another experiment.

Usage:

```
prompt> bis invalidate-experiment [-r <invalidation-reason>] <project code>
<experiment code>
```

Options:

- `-r <invalidation-reason>`, `--invalidation-reason=<invalidation-reason>`: Brief description why the experiment is invalidated. If the description contains spaces, it should be surrounded by quote signs, e.g. "operator error".

Parameter:

- `<project code>`: Code of the project to which the experiment belongs.
- `<experiment code>`: Code of the experiment. Available experiments can be listed by the command `list-experiments`.

invalidate-sample

Description: Invalidates one or more sample. The samples are specified by their codes in the command line and/or in a specified file.

Note:

- Control layouts can not be invalidated.
- All derived sample will also be invalidated. For plates, e.g. The hierarchy is as follows: master plate > dilution plate > cell plate > reinfection plate. For example, invalidation of a dilution plate means also invalidation of all cell plates derived from this dilution plate. In addition all reinfection plates of those cell plates are also invalidated.

Usage:

```
prompt> bis invalidate-samples [-r <invalidation-reason>] [-f <file with sample
codes>] [<sample code> ...]
```

Options:

- `-r <invalidation-reason>`, `--invalidation-reason=<invalidation-reason>`: Brief description why the samples will be invalidated.
- `-f <file with sample codes>`, `--sample-names-file=<file with sample codes>`: File with codes (one per line) of all sample to be invalidated. `Invalid_plates.txt` can serve as template.

Parameter:

- `<sample code>`: Zero or more sample codes.

Alias name: `invlirate-plates`

register-experiment-type

Description: Registers a new experiment type.

Usage:

```
prompt> bis register-experiment-type <experiment type code> [<experiment type description>]
```

Options: No additional options.

Parameter:

- `<experiment type code>`: Code of the new experiment type. It has to be unique and is restricted to 40 characters long max.
- `<experiment type description>`: A description of the new experiment type, intended for the users of the system.

register-file-format-type

Description: Registers a new file format type.

Usage:

```
prompt> bis register-file-format-type <file format type code> [<file format type description>]
```

Options: No additional options.

Parameter:

- `<file format type code>`: Code of the new file format type. It has to be unique and is restricted to 40 characters long max.
- `<file format type description>`: A description of the new file format type, intended for the users of the system.

register-master-plate

Description: Registers a master plate from a specified file.

Note:

- The name of the file without extension serves as the code of the master plate.
- Property `PLATE_GEOMETRY` is mandatory for master plates and must be specified. Available plate geometries can be listed using `get-vocabulary-info PLATE_GEOMETRY` command.

Usage:

```
prompt> bis register-master-plate [-p <property code>=<property value>] [-f <properties file>] [-c <control layout code>] <master plate file> <material batch
```

```
code>
```

Options:

- `-c <control layout code>`, `--control-layout=<control layout code>`: Code of a control layout which is optionally associated with the master plate to be registered. The command `list-control-layouts` lists all available values.
- `-p <property code>=<property value>`, `--property=<property code>=<property value>`: Setting the value of the property named `<property code>`. This can only be used for setting one property. If you want or have to set more than one property, use the `-f` option with a properties file.
- `-f <properties file>`, `--properties-file=<properties file>`: A tab-separated file with two columns (named `code` and `value`) for all properties to be set.
- `--empty <empty-plate-name>`: should be used to create an empty master plate. When this option is given, master plate file should not be specified.

Parameter:

- `<master plate file>`: A tab-separated file with the following mandatory columns (see `MP001-1.txt` as an example):
 - `code`: The well code specified in the format `<row letter><two colum digits>`.
 - `material`: The code of the material of type specified in column `material_type`.
 - `material_type`: The code of a material type. The command `list-material-types` lists all available values.
- `<material batch code>`: An arbitrary text specifying the instance of all materials associated in the master plate to be registered.

register-materials

Description: Registers materials from a specified file.

Usage:

```
prompt> bis register-materials <material type code> <material file>
```

Options: No additional options.

Parameter:

- `<material type code>`: The code of the type of materials to be registered. The command `list-material-types` lists all available values.
- `<material file>`: Tab-separated file which contains one material and its properties per line. It has the mandatory column `code` which contains the material code which has to be unique for the specified material type

(maximum length: 40 characters). The column `inhibitor_code` contains the code of the material which is inhibited by the material to be registered. This is a mandatory column if the material type is `OLIGO`. Additional columns are determined by the property types assigned to the specified material type. The command `get-material-type-info` lists all available columns. The name of the column in the material file has to be the same (ignoring case) as the property type code. Columns of non-mandatory properties are optional in the material file. See `exampleGenes.txt`, `exampleOligos.txt`, `controls.txt`, `viruses.txt` for example input files.

register-material-type

Description: Registers a new material type.

Usage:

```
prompt> bis register-material-type <material type code> [<material type description>]
```

Options: No additional options.

Parameter:

- `<material type code>`: Code of the new material type. It has to be unique and is restricted to 40 characters long max.
- `<material type description>`: A description of the new material type, intended for the users of the system.

register-observable-type

Description: Registers a new file format type.

Usage:

```
prompt> bis register-observable-type <observable type code> [<observable type description>]
```

Options: No additional options.

Parameter:

- `<observable type code>`: Code of the new observable type. It has to be unique and is restricted to 40 characters long max.
- `<observable type description>`: A description of the new observable type, intended for the users of the system.

register-project

Description: Registers a new project.

Usage:

```
prompt> bis register-project <project code>
```

Options: No additional options.

Parameter:

- `<project code>`: Code of the new project. It has to be unique and not more than 40 characters long.

register-property-types

Description: Registers property types from a specified file.

Usage:

```
prompt> bis register-property-types <property types file>
```

Options: No additional options.

Parameter:

- `<property types file>`: A tab-separated file with the following mandatory columns (see examplePropertyTypes.txt for an example):
 - `code`: Code (i.e. name) of the property type to be registered. It has to be unique and not more than 40 characters long.
 - `label`: Label to be used for human readable output.
 - `description`: A brief description.
 - `data_type`: Code of the type of data associated with the property type to be registered. The following data types are available:

Data type code	Description
VAR CHAR	Text with not more than 1024 characters.
INTEG ER	32-bit integer number.
REAL	Double precision floating point number.
BOOLE AN	Boolean value: Either <code>true</code> or <code>false</code> ignoring case.
TIMES TAMP	Time stamp (i.e. date and time).
CONTR OLLED VOCAB ULARY	This type is useful when you want to have a text property, but its values should be restricted to a certain set of controlled vocabularies. In the <code>vocabulary</code> column the name of the set should be specified if this type is used.

When the property has a `TIMESTAMP` type, it's value can be specified in following formats:

- full format with time zone (`yyyy-MM-dd HH:mm:ss Z`), e.g. `2007-12-24 16:59:59 +0200`.
- without a time zone (`yyyy-MM-dd HH:mm:ss`), e.g. `2007-12-24 16:59:59`. The local timezone will be assumed.
- without specifying seconds (`yyyy-MM-dd HH:mm`), e.g.

2007-12-24 16:59.

- specifying just a date, without the time (yyyy-MM-dd), e.g. 2007-12-24. The midnight of that day in the local time zone will be assumed as the time. where yyyy is the year, MM is the month (as number), dd is the day in the month, HH is the hour (0-23), mm is the minute, ss is the second, and Z is the time zone.
- `vocabulary`: Optional, should be specified only when `data_type` is `CONTROLLEDVOCABULARY`. The value should be the name of the controlled vocabulary set which restricts the set of allowed values (see `examplePropertyTypesWithVocabularies.txt` for an example). The available vocabularies can be displayed by `list-vocabularies` command.

register-sample-type

Description: Registers a new sample type.

Usage:

```
prompt> bis register-sample-type <sample type code> [<sample type description>]
```

Options: No additional options.

Parameter:

- `<sample type code>`: Code of the new sample type. It has to be unique and is restricted to 40 characters long max.
- `<sample type description>`: A description of the new sample type, intended for the users of the system.

register-vocabulary

Description: Registers controlled vocabulary set with given terms. To browse existing controlled vocabulary set see `list-vocabularies` and `get-vocabulary-info` commands.

Usage:

```
prompt> bis register-vocabulary <vocabulary-name> <vocabulary-terms-file>
```

Options:

- `--add-terms`: If specified, the terms from `<vocabulary-terms-file>` will be added to already existing `<vocabulary-name>`.

Parameter:

- `<vocabulary-name>`: Name of the controlled vocabulary set
- `<vocabulary-terms-file>`: The file with vocabulary terms. Each term should be in one line. There should be no header. The following file can serve as an example: `exampleVocabularyTermsOrganism.txt`

unassign-control-layout-property-type

Description: Unassigns a property type from control layout.

Note: This automatically deletes all values of the specified property type for all control layouts.

Usage:

```
prompt> bis unassign-control-layout-property-type [--force] <property type code>
```

Options:

- `--force`: Attempts to unassign the property type without asking the user for confirmation.

Parameter:

- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

unassign-experiment-property-type

Description: Unassigns a property type from an experiment type.

Note: This automatically deletes all values of the specified property type for all experiments of the specified type.

Usage:

```
prompt> bis unassign-experiment-property-type [--force] <experiment type code>  
<property type code>
```

Options:

- `--force`: Attempts to unassign the property type without asking the user for confirmation.

Parameter:

- `<experiment type code>`: Code of the experiment type. The command `list-experiment-types` lists all available values.
- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

unassign-material-property-type

Description: Unassigns a property type from a material type.

Note: This automatically deletes all values of the specified property type for all materials of the specified type.

Usage:

```
prompt> bis unassign-material-property-type [--force] <material type code>  
<property type code>
```

Options:

- `--force`: Attempts to unassign the property type without asking the user for

confirmation.

Parameter:

- `<material type code>`: Code of the material type. The command `list-material-types` lists all available values.
- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

unassign-plate-property-type

Description: Unassigns a property type from a plate type.

Note: This automatically deletes all values of the specified property type for all plates of the specified type.

Usage:

```
prompt> bis unassign-plate-property-type [--force] <plate type code> <property type code>
```

Options:

- `--force`: Attempts to unassign the property type without asking the user for confirmation.

Parameter:

- `<plate type code>`: Code of the plate type. The command `list-plate-types` lists all available values.
- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

unassign-sample-property-type

Description: Unassigns a property type from a sample type.

Note: This automatically deletes all values of the specified property type for all sample of the specified type.

Usage:

```
prompt> bis unassign-plate-property-type [--force] <sample type code> <property type code>
```

Options:

- `--force`: Attempts to unassign the property type without asking the user for confirmation.

Parameter:

- `<sample type code>`: Code of the sample type. The command `list-sample-types` lists all available values.
- `<property type code>`: Code of the property type. The command `list-property-types` lists all available values.

Command line options

General Options

Short Option	Long Option Name	Description
-h	--help	Shows a help text with a brief description of all options and arguments.
-s <base URL>	--server-base-url=<base URL>	The base URL of the openBIS server.

Command specific options

Short Option	Long Option Name	Description	Command(s)
	--force	Attempts to unassign the property type without asking the user for confirmation.	unassign-material-property-type
	--add-terms	If specified, terms read from the input file will be added to existing vocabulary.	register-vocabulary
-a	--show-also-invalid	Also invalid plates are shown if this flag is specified.	get-plate-locations, list-cell-plates, list-dilution-plates, list-experiments, list-master-plates, list-reinfection-plates list-experiment-plates list-experiment-samples list-experiment-datasets
-b	--buffer	If specified, the output on the console is stopped when the screen is full.	get-plate-info, list-cell-plates, list-control-layouts, list-

Short Option	Long Option Name	Description	Command(s)
			dilution-plates, list-master-plates, list-materials, list-reinfection-plates
-c <control layout code>	--control-layout=<control layout code>	Control layout code	register-cell-plates, register-dilution-plates, register-master-plate, register-reinfection-plates
-d <root directory>	--root-dir=<root directory>	Root directory of <experiment file> and all files	register-experiments
-e <experiment code>	--experiment=<experiment code>	Code of an experiment.	get-plate-locations
-f <file path>	--load-values=<file path>	A tab-separated text file (specified by <file path> with two columns.	assign-material-property-type
-f <file with plate codes>	--plate-names-file=<file with plate codes>	File with codes (one per line) of all plates to be invalidated.	invalidate-plates
-g <global value>	--global=<global value>	Global default value for entities that are not specified in an external file.	assign-experiment-property-type, assign-material-property-type, assign-sample-property-type
-i	--gene-id	Parameter <gene-symbol or id> is interpreted as gene id if this flag is specified.	get-plate-locations
-l <number of lines>	--limit=<number of lines>	Maximum number of lines to be shown.	list-cell-plates, list-control-layouts, list-dilution-plates, list-master-plates, list-materials, list-reinfection-plates
-m[<mandatory flag>]	--mandatory[=<mandatory	If <mandatory flag> is true or missing the assign	assign-material-property-type

Short Option	Long Option Name	Description	Command(s)
	flag>]	property type will be a mandatory one.	
-n	--no-experiment	Only plates registered to an experiment are shown.	list-cell-plates, list-reinfection-plates
-o <study object code>	--study-object=<material code>	Material code of the object to be studied.	get-plate-locations, list-experiments
-o <organization code>	--organization-code=<organization code>	Code of an organization.	login
-p <project code>	--project=<project code>	Code of a project.	get-plate-locations, list-experiments
-p <property code>=<property value>	--property=<property code>=<property value>	Setting the value of the property <property code>.	register-control-layout, register-master-plate
-p <password>	--password=<password>	The password of the user to be authenticated.	login
-P	--pretty-print	Shows the data in a pretty printed format which is more human readable than the tab-separated one.	get-control-layout-info, get-material-type-info, get-plate-info, get-vocabulary-info, list-cell-plates, list-contacts, list-control-layouts, list-dilution-plates, list-experiment-types, list-experiments, list-master-plates, list-material-types, list-materials, list-plate-types, list-projects, list-property-types, list-reinfection-plates, list-vocabularies, list-experiment-attachments, list-experiment-

Short Option	Long Option Name	Description	Command(s)
			datasets, list-processing-instructions
-r <invalidation-reason>	--invalidation-reason=<invalidation-reason>	Brief description why the experiment is invalidated.	invalidate-experiment, invalidate-plates
-t <time interval>	--time-interval=<time interval>	A query restriction on the time interval.	get-plate-locations, list-experiments
-u <login name>	--username=<login name>	The login name of the user to be authenticated.	login
-v <version number>	--attachmentVersion=<version number>	Version of the requested file.	get-experiment-attachment

Time interval specification

For some commands of the command line client a time interval can be specified by the option `-t`. This time interval has to be specified as follows

```
[<from>]:[<until>]
```

A missing `<from>` specification means minus infinity. A missing `<until>` specification means now.

The time itself is specified either absolutely in the form

```
<4 digit year>-<2 digit month>-<2 digit day>
```

or relatively in the form

```
now-<number><unit>
```

where `<unit>` is either

Unit	Description
h	hour
d	day
w	week = 7 days
m	month = 30 days
y	year = 365 days

Examples:

Example	Meaning
:2007-12-10	Before 10th December 2007
2007-08-01:2007-12-01	Between 1st August 2007 until 1st December 2007
now-2d:	The last two days
now-3m:now-5h	The last three months but not in the last 5 hours

Biological Data Standard

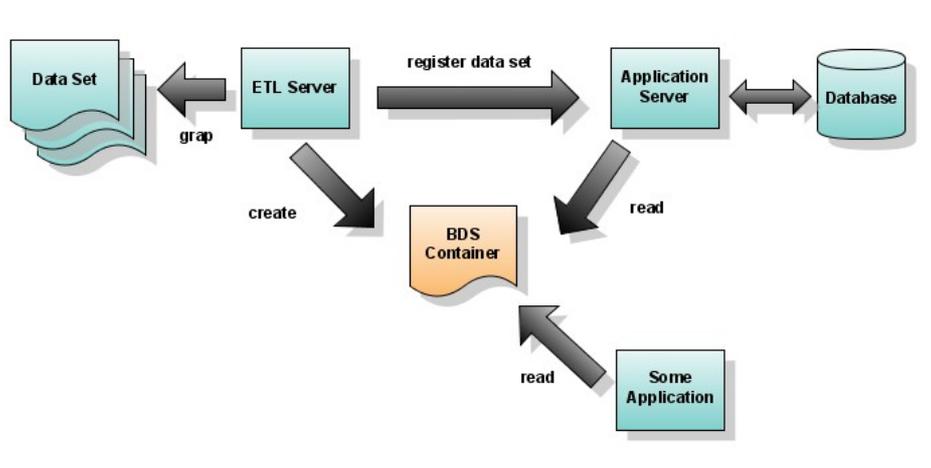
This page describes the Biological Data Standard (BDS) used in the CISD software systems for data not stored in the database.

Motivation and Goals

The ETL Server receives sets of large measurement or analysis data. These data sets are usually too large to be stored completely in the database. When the data set is registered at the application server only meta data are stored in the database. What to do with data? They have to be stored in the file system in a way that

- User can get an identifier for the corresponding experiment meta data stored in the database.
- Some of the meta data are available even if the database isn't accessible. This is not only for the sake of the user but also for some external software doing further analysis of the data.
- The data should be organized in a standardized way independent of the usually non-standard original organization of the data. For each domain (e.g. high-content screening, proteomics mass-spectrometry, etc.) the standard is of course different.
- The data should be organized in a way as they are usually needed by analysis programs.
- The way data is stored and organized should be consistent across different domains. For example, a date/timestamp should be always stored in the same format.
- The standard should be versioned. If possible new versions should be backwards compatible.

The solution is to store the data and additional meta data in a container (called **BDS Container**). The ETL Server creates such a container from the received data. The relative path to the container is registered in the database. The application server (or any other program) can access the data in the BDS Container.



This wiki space contains all the specification of the Biological Data Standard. There is also Java API developed for creating and reading BDS Containers.

Concepts

Important concepts and terms of BDS are defined here.

Data, Metadata and Annotation

- **Data** are any kind of data produced by some measurements, analyses or calculations.
- **Metadata** are data about the above mentioned data. Metadata are partially bundled with the data. Some metadata are stored in the openBIS database. If this is the case the metadata bundled with the data contains information which allows to retrieve the missing part of the metadata from openBIS.
- **Annotation** are additional data which are not required to make sense of the data but might be interesting anyway.

Directory, File, and Link

The data is organized hierarchical as a **tree**. There are three different types of **nodes**:

- **Directory**: A node with children.
- **File**: A leaf node (i.e. childless node). A file has a **value** which can be either textual or binary data.
- **Link**: A reference to another node of any type anywhere in the tree. Cyclic dependencies are not allowed. An additional file with the relevant information of all links has to be provided in order to restore broken links.

All nodes have in common that they have a **name** which has to be unique in their parent directory. The tree itself is a nameless root directory. How structures are represented in this document see Structure Representation Syntax and Semantics.

Container

A **container** is a physical representation of a tree. The following representations will be supported:

- **File system**: Directories and files are easily translated into their corresponding file system representatives. For links hard link should be used if possible. All files (except the original data) should be ASCII files and optimized for reading by programs (e.g. using TAB-separated value format for tables)
 - Advantage:
 - Easy access by scripts and programs in any language (Perl, Python, Java, C, Matlab, R, S, Spotfire, etc.).
 - Disadvantages:
 - Not efficient concerning memory consumption
 - Bad performance in Hierarchical Storage Management (HSM)

- solutions because of lots of small files
 - No platform-independent solution for links
- **HDF5**: A BDS Container is a HDF5 file. Directories are represented by HDF5 groups. Files are represented as binary data like vectors, matrices etc.
 - Advantages:
 - Efficient use of memory and CPU resources
 - Suitable for HSM solutions because only one (big) file has to be handled.
 - Available on many platforms
 - Independent from the file system of the platform
 - Disadvantages:
 - Needs HDF5 library.
 - Programming non-trivial.

To overcome the disadvantages of an HDF5 container a conversion program will be provided which converted one BDS Container representation into another one.

Structure

A **structure** is a definition of how the data are organized in a tree. It is a kind of template. It has a version which is stored in the root directory.

Format

As **format** is a set of definitions needed in order to make sense of the data itself.

Even though this is a rather vague definition a concrete format is very specific. It may consist of:

- directory layout (this means for a given format one knows what sub-directories to expect in the /data directory)
- what entity the data set refers to (e.g. a screening plate)
- what entities sub sets contained in this data set refers to (e.g. wells or tiles on a screening plate)
- whether it is raw or derived data
- if applicable: what coordinate system is used to organize the data (e.g. wells and tiles for RNAi images)
- if applicable: what experimental condition description system is used to organize the data (e.g. the channels of a microscope); note that this is usually kind of a template that needs to have parameters to be filled in (e.g. the wavelengths of the channels)
- the format(s) of a single entity in the data set (e.g. a tiff image or a float vector)

Format Variant

A format can contain variants. A **variant** leaves some room to customize a format in that it allows to decide on parts of the format on a case by case basis. All variant

parameters need to be fully specified for a given instance of a data set of a given format.

An example of a variant is whether a raw data set contains the original data as measured by the instrument or only the standardized form. Another example could be the image format of RNAi screening plates, i.e. whether they are tiff or png.

Note that the number of variants should be kept to a minimum, because standards with lots of variants are difficult to implement and are quite often implemented incompletely (just assuming that it will be always one of the variants and neglecting the other variants).

Format Building Block

A **format building block** is a re-usable format (e.g. the coordinate system for screening plate). It has its own page in the wiki and can be referred by other formats or format building blocks.

Version

Because the organization of data will change over time a structure and a format will have a **version**. It is specified by two non-negative integers: **major version** and **minor version**. Whenever changes to a definition (structure or format) need to be made the corresponding version will be increased. There are two types of increases:

- New minor version: The minor version number is increased by one. A minor version must be *backward compatible* to all previous minor versions of the same major version. A version is called backward compatible if software written for an earlier version can also handle any data structured/formatted in accordance with the newer version. Backward compatible versions typically extend the structure/format by additional stuff.
- New major version: The major version number is increased by one and the minor version is set to zero. A major version is not required to be backward compatible to any previous version.

The structure of the version information is as follows:

```
version/  
  major  
  minor
```

The version structure itself is not versioned.

In texts a version should be written as follows:

```
V<major>.<minor>
```

For example, V2.1 means major version 2 and minor version 1.

Data types

Flags

Flags can only have one of the following values: `TRUE` (meaning `yes`) or `FALSE` (meaning `no`).

XFlags

Extended Flags (XFlags) can only have one of the following values: `TRUE` (meaning `yes`), `FALSE` (meaning `no`) or `UNKNOWN` (meaning it's value is not known to the system).

Enumerations

The allowed items of an enumeration are written in capital letters. No spaces will be used, but instead an underscore. Only characters and numbers are allowed here. A correct example is `ORIGINAL_DATA`.

Dates

Dates are always given in the following format:

```
yyyy-MM-dd HH:mm:ss Z
```

where:

- `yyyy` is the year (4 digits)
- `MM` is the month (2 digits)
- `dd` is the day of the month (2 digits)
- `HH` are the hours (counting from 0 to 23, 2 digits)
- `mm` are the minutes (2 digits), `ss` are the seconds (2 digits)
- `Z` is the time zone relative to GMT (4 digits and a sign symbol in accordance with [RFC 822](#). For central Europe it would be `+0100`)

Lists

Lists are ordered collections of items. In a *file system container* a list will be represented as a file which contains one item per line, i.e. different items of the list will be separated by a `LF` character.

Units

When a quantity requires a unit, this unit has to be specified in the format. For example, a format will specify whether a wavelength is given in `nanometers` or in `angstroms`. There will be no shortcuts for units appended to the quantities itself.

Structure Representation: Syntax and Semantics

In this documentation a textual representation of the tree or a subtree is used. Its syntax and semantics is best explained by an example:

```
version/  
  major = 2  
  minor = 1  
data/  
  original/  
    xyz08-001.tiff  
    xyz08-002.tiff  
  standard/  
    xyz08/  
      001.tiff -> data/original/xyz08-001.tiff  
      002.tiff -> data/original/xyz08-002.tiff  
metadata/
```

Here are the rules:

- Directories end with '/'.
- Child nodes are intended by 3 spaces relative to their parent directory.
- If a file is followed by an equals sign '=' it means that the file has the value as specified what follows the equal sign.
- Links have a '->' after their name followed by the full path to their referring node.

Naming Conventions

Directories, files, and links created to organize the data have to fulfill a naming convention. The name of original data files and folders are left unchanged even though they are not conform to the naming convention.

Rules:

- A name contains only lower-case letters, decimal digits, and '_'.
- A file or a link referring to a file can contain one dot character '.'.
- A name starts either with a letter or a digit.

BDS Structure V1.0

With all definitions we follow the "**principle of least surprise**". So if for example a standard defines one way to store a structure for wells, and such a structure is needed in two places, they are supposed to look the same.

Template

```
version/
  major = 1
  minor = 0
data/
  original/
  standard/
metadata/
  data_set/
    code = 20080402142616324-198
    production_timestamp = 2008-04-02 08:03:23 +0100
    producer_code = M1
    observable_type = HCS_IMAGE
    is_measured = TRUE
    is_complete = TRUE
    parent_codes = 20080402142616674-197
                  20080402142656712-196
  format/
    version/
      major = 2
      minor = 1
    code
    variant
  experiment_identifier/
    instance_code = IMSB
    group_code = LP
    project_code = NEMO
    experiment_code = EXP1
  experiment_registration_timestamp = 2007-06-23 21:07:08 +0100
  experiment_registrator/
    first_name = John
    last_name = Doe
    email = John.Doe@organization.org
  sample/
    type_description = Screening Plate
    type_code = CELL_PLATE
    code = CP001A-3AB
  md5sum/
    original
    standard_original_mapping = ch1/row3/col4/row1_col1.tiff  I
NEMO.EXP1::CP001A-3AB/xyz08-001.tiff
                                ch1/row3/col4/row1_col2.tiff  I
NEMO.EXP1::CP001A-3AB/xyz08-002.tiff
                                ch1/row3/col4/row1_col12.tiff I
NEMO.EXP1::CP001A-3AB/xyz08-012.tiff
  parameters/
    plate_geometry/
    well_geometry/
    contains_original_data = TRUE
  annotations/
    channel1/
      wavelength = 123
    channel2/
      wavelength = 300
```

Explanations

The meaning of the various nodes in this structure are explained in the following sections. For more information about terms, concepts, and structure representation see Introduction and Concepts and Structure Representation Syntax and Semantics.

version

This directory specifies the version of the structure used.

data

This directory contains the measured or computed data.

data/original

This directory will contain the original data as they have been received from the ETL server. These files are mainly data files (e.g. images) but they also could be accompanied by some log or other helper files that should not be mapped in the standard directory. Although one could argue that we have redundancy between the name of the folder received NEMO.EXP1::CP001A-3AB and the values found in experiment identifier, we want to keep these original data as *original* as possible.

Example

Assuming the following folder has been received:

```
NEMO.EXP1::CP001A-3AB/  
  xyz08.log  
  xyz08-001.tiff  
  xyz08-002.tiff  
  xyz09.log  
  xyz09-001.tiff
```

It will be imported as follows:

```
data/  
  original/  
    NEMO.EXP1::CP001A-3AB/  
      xyz08.log  
      xyz08-001.tiff  
      xyz08-002.tiff  
      xyz09.log  
      xyz09-001.tiff
```

data/standard

This directory contains the data structured in a standard way defined by the format. In order to save storage space data files are not duplicated but referred by [hardlinks](#).

To continue the example from above the structure in `data/standard` might look like as follows:

```
data/  
  original/  
    NEMO.EXP1::CP001A-3AB/  
      xyz08.log  
      xyz08-001.tiff
```

```

xyz08-002.tiff
xyz09.log
xyz09-001.tiff
standard/
  ch1/
    row3/
      col4/
        row1_col1.tiff ->
data/original/NEMO.EXP1::CP001A-3AB/xyz08-001.tiff
        row1_col2.tiff ->
data/original/NEMO.EXP1::CP001A-3AB/xyz08-002.tiff
        row1_col3.tiff ->
data/original/NEMO.EXP1::CP001A-3AB/xyz09-001.tiff

```

The actual structure in `data/standard` depends on the format which is specified by `metadata/format/format_code`. It also specifies the link label format and answers questions like: which part comes first, space coordinates or experiment conditions?

metadata

This directory contains some metadata of the data stored in `data` and informations which allows to query *openBIS* for additional metadata.

metadata/data_set

Nodes in this directory specify information about the data set.

- `metadata/data_set/code`: is a unique identifier that allows to find the data set in the database.
- `metadata/data_set/production_timestamp`: Date, in the default format, which provides the information when the data set has been created (either measured or calculated).
- `metadata/data_set/producer_code`: identifies the "device" that produced the data set (which can be a measurement device like a microscope or a software program).
- `metadata/data_set/observable_type`: is a code that describes the type of data that is stored in this standard. It is an Enumeration and possible values are `HCS_IMAGE` or `HCS_IMAGE_ANALYSIS_DATA`. Usually one BDS standard will always have one observable type.
- `metadata/data_set/is_measured`: Flag specifying whether the data set has been *measured* from a sample (`TRUE`) or whether it has been *derived* by means of some calculation from another data set (`FALSE`).
- `metadata/data_set/is_complete`: Xflag specifying whether the data set is complete or not, i.e. whether it contains all files that it is expected to contain. Not all storage processors can assess whether a data set is complete. Thus the value of can be `TRUE`, `FALSE` or `UNKNOWN`.
- `metadata/data_set/parent_codes`: is only non-empty if `is_measured` is `FALSE`. In this case, it will contain a List) of codes that this data set has been derived from.

metadata/format

Nodes in this directory define the format of the data in `data/standard`.

- `metadata/format/code`: specifies the code of the format definition.
- `metadata/format/version`: specifies the format version. It is completely independent to the structure version of the data structure.
- `metadata/format/variant`: This is optional in general (though for a given data standard it will be either always present or always absent, depending on whether the data standard has variants or not) and specifies a variant of the format. Its value has to be from a restricted vocabulary which is specified in the format definition (defined by the format code and version). A format variant can be thought of a name space of the `metadata/parameters` directory, so a certain value of `format_variant` will tell the user what entries he or she can expect in `metadata/parameters`. Note that there may be flags in `metadata/parameters` which may indicate further variations to a format, as defined in the format definition.

Depending on the format code this directory may contain additional nodes.

metadata/experiment_identifier

The *experiment identifier* is used to get all the metadata from the *openBIS* database. Four codes are needed to specify it uniquely:

- `instance_code`: identifier of the openBIS server instance
- `group_code`: identifier of the research group / lab
- `project_code`: identifier of the research project that this experiment has been performed in
- `experiment_code`: identifier of the experiment

metadata/experiment_registration_timestamp

The date, in the default format (see Dates), when the experiment specified by `metadata/experiment_identifier` was registered.

metadata/experiment_registrator

The name of the registrator of the experiment. It contains the mandatory files `first_name`, `last_name`, and `email`.

metadata/sample

The *sample* that the values of this data set are either *measured from* or *derived from* via processing, e.g. a screening plate.

- `type_code`: is a unique identifier of the type of the sample. It is an Enumeration and current possible values are `CELL_PLATE` or `REINFECT_PLATE`.

- `type_description`: is a free text description of the type of sample intended to be used by the human reader only. Note that these data are redundant, because a data format implicitly specifies this type.
- `code` can be tracked back to the database, e.g. CP001A-3AB is a barcode of a screening plate.

metadata/md5sum/original

The `original` folder should be checked for integrity (i.e., to verify that a file has not changed as a result of file transfer, disk error, human meddling, etc.). This can be achieved by calling `gmd5sum` on *Mac OS X*. For an introduction to `md5sum` and an 'HOWTO' to install `gmd5sum` on *Mac OS X*, have a look at <http://www.answers.com/topic/md5sum>. For a fast *Java* implementation of `MD5`, see http://www.twmacinta.com/myjava/fast_md5.php.

Typically you will perform following command to create the desired `md5sum` file (in our case for the `original` directory):

```
find . -type f -exec gmd5sum {} \; > original
```

The output file (`original`) will have the following format:

```
a7efaa48fdf59e0ee4308df7e5252bf4 NEMO.EXP1::CP001A-3AB/xyz08.log
7687bc40fe2af4f80c7f8fede5c9e16c NEMO.EXP1::CP001A-3AB/xyz08-001.tiff
b157aa7e1909089f04cf58albb752b54 NEMO.EXP1::CP001A-3AB/xyz08-002.tiff
934df91fe90108a9a12858aeed23e779 NEMO.EXP1::CP001A-3AB/xyz09.log
05098dc194e09e24334298c32ca87538 NEMO.EXP1::CP001A-3AB/xyz09-001.tiff
```

Between the checksum and the file path are two space characters. The file path (with '/' as name separator) is relative to `data/original`.

metadata/standard_original_mapping

This is a file containing information about the relationship between a file in `data/standard` and `data/original`. Each line of this file contains three items separated by a TAB character:

1. Path in `data/standard`: Existing path. Occurs only once in this file. The file path separator is system independent and is '/'.
2. Type of Relationship: I or T.
3. Path in `data/original`: this can be any valid and existing path (may contain TAB characters). The file path separator is system independent and is '/'.

The meaning of the type of relationship is as follows:

- **I (IDENTICAL)**: The first path is pointing to a [hardlink](#) in `data/standard` and the second path is pointing to the originale file in `data/original`. Such mapping entry is only necessary if the hardlink is broken for some reason.
- **T (TRANSFORMED)**: Both paths pointing to files with different content. The first path is pointing to a file that is the transformation resp. standardization form of the file referred by the second path. This is a typical situation for derived data because we want to standardize these data. On the other one may

still want to know the corresponding original data file because it could contain information which is lost due to standardization.

Note: This file can be empty.

metadata/parameters

The `parameters` sub-directory contains all parameters that are specific to a certain data format. Consequently, the content of this directory needs to be defined in the data format definition. With *parameters* we mean the information one needs to make sense of the *format* of the data in `data/` directory. An example of parameters is the plate dimension and the well dimension for tiled plate-based data.

For information that is needed to make sense of the *content* of the data, see `annotations/` instead. So for example for plate-based data the channel wavelengths or the mapping table from biological materials to wells wouldn't belong to `metadata/standard` but to `annotations/`.

annotations

The directory `annotations/` is reserved for all information that is specific to a data standard but that is neither measured data (which is found in `data/`) nor is it required to make sense of the data structure in `data` (which can be found in `metadata/parameters`). Rather it is information that is needed to make sense of the content of the data or is needed for quality control. An example of information that should be placed here is the wavelength of a fluorescent measurement or the id of the device that was used to measure it.

The content of the `annotations/` directory is completely defined in each data standard.

Unknown (UNKNOWN) 1.0

This format is used when nothing is known about the format of the data. In this case the directory `data/standard` of the structure does not exist (see BDS Structure V1.0).

HCS IMAGE 1.0

HCS (High-Content Screening) with Images

For the general description of the biological data standards, please refer to BDS Structure V1.0

Description of data stored in this format

This data standard is supposed to store image data from High Content Screening

(HCS) experiments. Such experiments are performed on *plates* which consist of *wells* containing the system to be tested. Typical plate geometries have 8x12 or 16x24 wells.

In HCS experiments, an automated microscope takes images of every well. Since in the common case the display window of the microscope is too small to cover a complete well in the required magnification, the microscope takes several images of every well, that, when put together, depict the complete well. Such images which show only a part of a well are called a *tile* in the following.

HCS fluorescence microscopes are typically able to measure more than one color (or wavelength). Common devices can measure up to 4 colors in 4 *channels*. One *channel* thus represents one color which is described by its wavelength.

One data set as described below represents the image data taken from one plate.

Directory metadata/data_set

For the description of the metadata directory, please be referred to metadata.

The metadata/data_set/observable_type for this format is HCS_IMAGE.

Directory metadata/format

For the description of the metadata directory, please be referred to metadata.

The metadata/format/format_code for this format is HCS_IMAGE, the metadata/format/version is 1.0 (for the structure of format specifiers, see metadata/format).

This format does not have any variants.

Directory metadata/parameters

The metadata subdirectory parameters contains the following children (all parameters are mandatory):

1. **plate_geometry**. This is the geometry of a *plate*, i.e. the number of wells per column and per well. A typical value is 16x24.
2. **well_geometry**. This is the geometry of a *well*, i.e. the number of tile images per column and per well. A typical value is 3x3.
3. **number_of_channels**. It specifies the number of *channels* we are going to find here.
4. **contains_original_data**. Flag specifying whether the data directory contains the original data or not.
In the later case only the standardized data are available (located in data/standard directory). No file is located in data/original directory and the mapping file in metadata/standard_original_mapping is thus empty.

An example structure of the metadata/parameters hierarchy looks like this:

```

metadata/
  parameters/
    plate_geometry/
      rows = 16
      columns = 24
    well_geometry/
      rows = 3
      columns = 3
    contains_original_data = TRUE
    number_of_channels = 2

```

Directory annotations

The directory annotations contains the following children (all entries are mandatory):

1. **channelN**. In this format, the only setting is the wavelength of the channel. It is provided in the unit of *nanometers*. We may have **one or more channels** (see `metadata/parameters/number_of_channels` for how many there are). The channels are serially numbered starting with 1.

An example structure of the annotations hierarchy looks like this:

```

annotations/
  channel1/
    wavelength = 123
  channel2/
    wavelength = 200

```

Directory data/standard

In the `data/standard` all images of one plate are stored, hierarchically ordered by:

1. *Channel* denoted by `channelL`
2. *Plate Row* denoted by `rowN`
3. *Plate Column* denoted by `columnM`

One directory thus corresponds to one well and one color. It contains image data for all tiles of the particular well and color. Each image is named according to the schema `rowN_columnM`, where N and M are the row and column number of the tile. The image is stored in standard **tiff** format.

The numbering of rows and columns always starts with 1 (rather than 0).

Example (here in the case where original data are stored, the dependency between standardized data and original data are symbolically depicted by "`->`"):

```

data/
  standard/
    channel1/
      row1/
        column1/
          row1_column1.tiff -> NEMO.EXP1::CP001A-3AB/xyz08-001.tiff
          row1_column2.tiff -> NEMO.EXP1::CP001A-3AB/xyz09-001.tiff
    channel2/
      row1/
        column1/
          row1_column1.tiff -> NEMO.EXP1::CP001A-3AB/xyz08-002.tiff
          row1_column2.tiff -> NEMO.EXP1::CP001A-3AB/xyz09-002.tiff

```

...

The reference which the dependency points to is relative to the `original` directory. Note that depending on the value of `contains_original_data` flag you will have here (hard) links (as depicted now) or independent (standardized) data sets.