

LUMI



Files on LUMI 2: LUMI-O object storage

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Why do I need to know this?

- LUMI-O is the primary option on LUMI to transfer large amounts of data to LUMI
- LUMI-O is the only local option if you want to backup some data
- Some datasets come in a format optimised for object storage rather than a parallel file system

- What we will discuss:
 - Properties of object storage
 - Getting started
 - But not a reference manual of the tools that can be used on LUMI-O

What is LUMI-O?

- Object storage system, based on Ceph
 - Finnish users: similar to Allas, but less functionality at the moment
 - Specific tools to access data, not mounted as a regular file system
- Organisation:
 - Buckets: “Containers” used to store objects.
 - Flat structure: Buckets cannot contain other buckets
 - Objects: Any type of data, stored in a bucket
 - Atomic access to objects: Put, get, copy, delete, ..., but no partial write
 - Metadata for buckets and objects
 - Bucket: e.g., access rights
 - Custom metadata possible

What is LUMI-O? (2)

- Objects can be served on the web also
 - This is how recordings of some LUST courses are served
 - But not meant as a data publishing service (e.g., no EUDAT alternative)
- Can be reached easily from outside LUMI
 - So also a mechanism for data exchange
 - Tools of object storage are more performance and more robust than sftp
- Specs:
 - Capacity: 30 PB
 - Quota: 150 TB capacity, 1K buckets and 500K objects per bucket (fixed)
 - Billed at 0.5 TB·hour per TB per hour
 - Persistent for the duration of the project

Lustre vs LUMI-O (1)

Lustre	LUMI-O object storage
Closely integrated with compute nodes	Separate system
Upgrades with the system	Separate upgrade cycle and on-the-fly
Organisation: Hierarchical directory structure and files	Organisation: Double flat space of buckets and objects
Files can be read, written, modified, appended, ...	Simple atomic operations on objects: put, get, copy, delete
Optimised for bandwidth to the compute nodes	Optimised for reliability
Simpler schemes for redundancy	Very complex internal redundancy setup

Lustre vs LUMI-O (2)

Lustre	LUMI-O object storage
Integrated in the authentication of the supercomputer	Separate key-based authentication mechanism
Seen as any other POSIX file system	Separate range of access tools/APIs, some tools can provide a filesystem view
No external access	External access integrated, includes web
Structure with MDS and ODS	Structure with MDS and ODS, but very different technologies
Parallelism for performance: Access a file in parallel from multiple processes	Parallelism for performance: Different processes access different objects
Fairly expensive to very expensive hardware	Cheaper hardware

LUSTRE vs LUMI-O (3)

- The optimal way/technology of storing data is very different depending on whether you work from a parallel file system or from object storage. E.g., in earth and climate science:
 - netCDF is a popular data storage format for storing simulation data on a parallel filesystem
 - Not suited for object storage though as it would be a single object
 - Zarr is a format to store similar data on object storage (cloud storage)
 - It is not a single object, but a structured collection of objects
 - Putting it on a parallel filesystem where each object would become a file in a directory tree is a very bad idea!
 - But with the right libraries, you can access Zarr data on object storage directly from your application

Accessing LUMI-O

- Access is based on keys
 - Generated via a web interface: Separate steps to generate the credentials and to get them on LUMI
 - Or generated via Open OnDemand: Will put credentials on LUMI for **TODO**.
- Tools:
 - `rc1one`: Easiest tool if you want public and private data
 - `s3cmd`
 - `restic`: More a backup tool
 - `boto3`: Python API from the AWS SDK for programmatic access
 - Needs a more recent Python version than the system Python
 - Additional GUI-based tools exist for clients
 - Open OnDemand web interface is not a substitute!
 - Speed limited by browser protocols

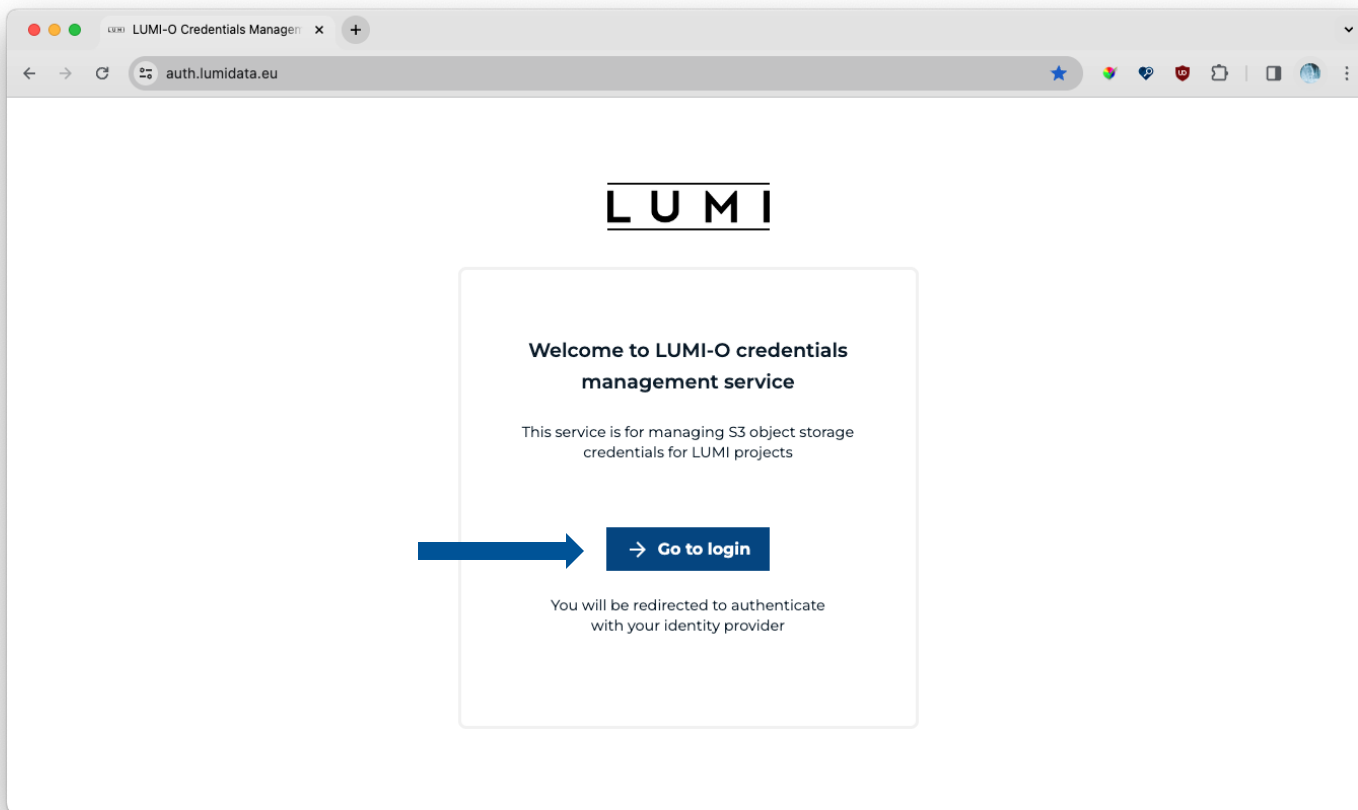
module `lumio`

Credential management web interface

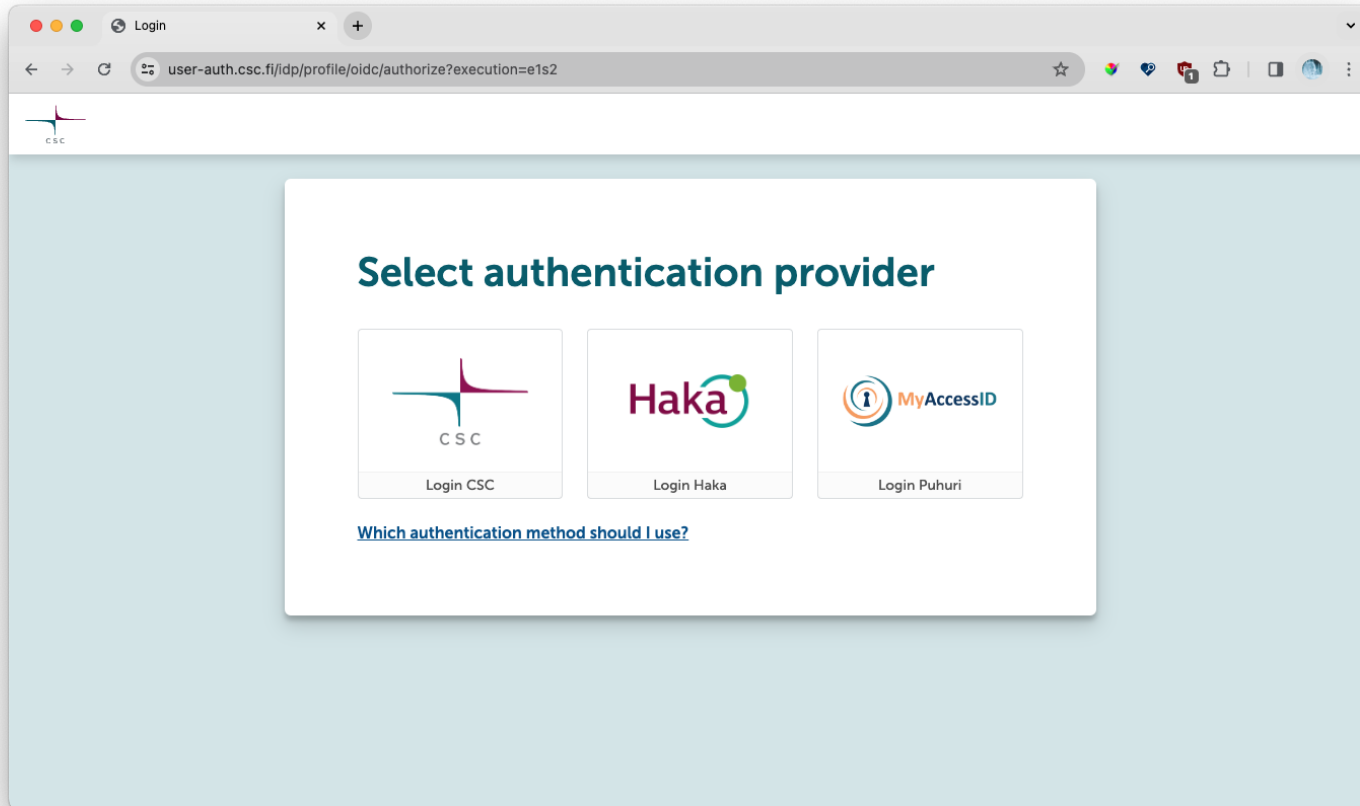
- Credential management web interface at auth.lumidata.eu
 - Create keys
 - Extend lifetime of a key
 - Create configure scripts for various tools
- You'll have to select your login method in the same way as for Open OnDemand
- After a while you should see a list of projects, select the one for which you want to generate a key
 - The right column will show active keys for the project, and expired ones
- Selecting an active access key changes the right column to one where you get information about the key, can extend the key and can generate templates to configure various tools

Credential management web interface: Create credentials (1)

LUMI



Credential management web interface: Create credentials (2)



Credential management web interface: Create credentials (3)

LUMI

The screenshot shows a web browser window with the URL `auth.lumidata.eu/projects/465001102`. The page header includes the LUMI logo and navigation links for [Help & Support](#), [Documentation](#), and [Logout](#).

Your projects

Project number	Project description
465000095	VLAAMS SUPERCOMPUTER CENTRUM / VSC-SUPPORT
465000297	LUST Training / Detailed introduction to the LUMI-C environment and architecture (23-24 Nov 22)
465000844	VLAAMS SUPERCOMPUTER CENTRUM / VSC-2023-04-T159-KH-EASYBUILD
465000961	LUST Training / 2024-02-08 LUMI Intro
465001098	LUST Training / 2024-04-23-26 LUMI General
465001102	LUST Training / 2024-05-02-03 Supercomputing with LUMI

A blue arrow points to the project number `465001102` in the table.

Authentication keys

Project number: 465001102

Generate a new authentication key pair

Both fields are required. Key duration may not exceed 168 hours.

Duration (hours)*:

Key description*:

[Generate key](#)

A blue arrow points from the `Generate key` button to the right.

Available keys

There are no keys to show.

The keys you generate will appear in this list.

Credential management web interface: Create credentials (4)

LUMI

The screenshot shows the LUMI Credentials Manager web interface. The browser address bar displays `auth.lumidata.eu/projects/465001102`. The page header includes the LUMI logo and navigation links for [Help & Support](#), [Documentation](#), and [Logout](#).

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465001098	LUST Training / 2024-04-23-26 LUMI General
465001102	LUST Training / 2024-05-02-03 Supercomputing with LUMI

The last row of the table is highlighted in light blue, and a blue arrow points from it to the 'Generate a new authentication key pair' section.

Generate a new authentication key pair

Both fields are required. Key duration may not exceed 168 hours.


Duration (hours)*

Key description*

[Generate key](#)

Available keys

Access key

 OGR2KN5PUPW929W9WPP4
Course demo
Expires on: Apr 18 2024 11:29:54 GMT+0200

Expired keys

The are no expired keys to show.

Credential management web interface: Check credentials

LUMI

The screenshot shows a web browser window with the URL `auth.lumidata.eu/projects/465001102/keys/OGR2KN5PUPW929W9WPP4`. The page features the LUMI logo and navigation links for Help & Support, Documentation, and Logout. On the left, a table titled "Your projects" lists several projects. The project with ID 465001102 is highlighted. A modal window titled "Authentication keys" is open on the right, displaying "Access key details" for the selected key. A blue callout box highlights the "Endpoint URL" as `https://lumidata.eu/`.

Project number	Project description
465000095	VLAAMS SUPERCOMPUTER CENTRI SUPPORT
465000297	LUST Training / Detailed introductory C environment and architecture (2)
465000844	VLAAMS SUPERCOMPUTER CENTRI 04-T159-KH-EASYBUILD
465000961	LUST Training
465001098	LUST Training
465001102	LUST Training / 2024-05-02-03 Sup with LUMI

Access key	OGR2KN5PUPW929W9WPP4
Secret key	LyYAKH4I5oULHMbwisOskQwdl6xkm03c2G8Jam9
Key description	Course demo
Project number	465001102
Project description	LUST Training / 2024-05-02-03 Supercomputing with LUMI
Creation time	Apr 11 2024 11:29:54 GMT+0200
Expires on	Apr 18 2024 11:29:54 GMT+0200

Endpoint URL: `https://lumidata.eu/`

Extend key duration
The expiry time of a key is calculated from the time of its generation and cannot
be extended beyond 630 days.

Credential management web interface: Extend credential lifetime

LUMI

The screenshot shows a web browser window with the URL `auth.lumidata.eu/projects/465001102/keys/OGR2KN5PUPW929W9WPP4`. The page features the LUMI logo and navigation links for Help & Support, Documentation, and Logout. The main content is divided into two sections: 'Your projects' and 'Extend key duration'.

Your projects

Project number	Project description
465000095	VLAAMS SUPERCOMPUTER CENTI SUPPORT
465000297	LUST Training / Detailed introducti C environment and architecture (2
465000844	VLAAMS SUPERCOMPUTER CENTI 04-T159-KH-EASYBUILD
465000961	LUST Training / 2024-02-08 LUMI Ir
465001098	LUST Training / 2024-04-23-26 LUM
465001102	LUST Training / 2024-05-02-03 Sup with LUMI

A blue arrow points from the 'Project description' column to the 'Extend key duration' section.

Extend key duration

The expiry time of a key is calculated from the time of its generation and cannot exceed a total of 168 hours.

Extend by (hours)

Configuration templates

Select configuration format to generate (opens in a new tab)

Select format

- shell
- boto3
- rclone
- s3cmd
- aws

manently disable all connections where this key has been he connection

Credential management web interface: Tool configuration (1)

LUMI

The screenshot shows a web browser window with the URL `auth.lumidata.eu/projects/465001102/keys/OGR2KN5PUPW929W9WPP4`. The page features the LUMI logo and navigation links for Help & Support, Documentation, and Logout.

Your projects

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465000095	VLAAMS SUPERCOMPUTER CENTI SUPPORT
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465001098	LUST Training / 2024-04-23-26 LUM
465001102	LUST Training / 2024-05-02-03 Sup with LUMI

Two blue arrows point from the project descriptions to the configuration options on the right. The first arrow points from the 'VLAAMS SUPERCOMPUTER CENTI 04-T159-KH-EASYBUILD' project to the 'Extend key duration' section. The second arrow points from the 'LUST Training / 2024-05-02-03 Sup with LUMI' project to the 'Configuration templates' section.

Extend key duration

The expiry time of a key is calculated from the time of its generation and cannot exceed a total of 168 hours.

Extend by (hours)

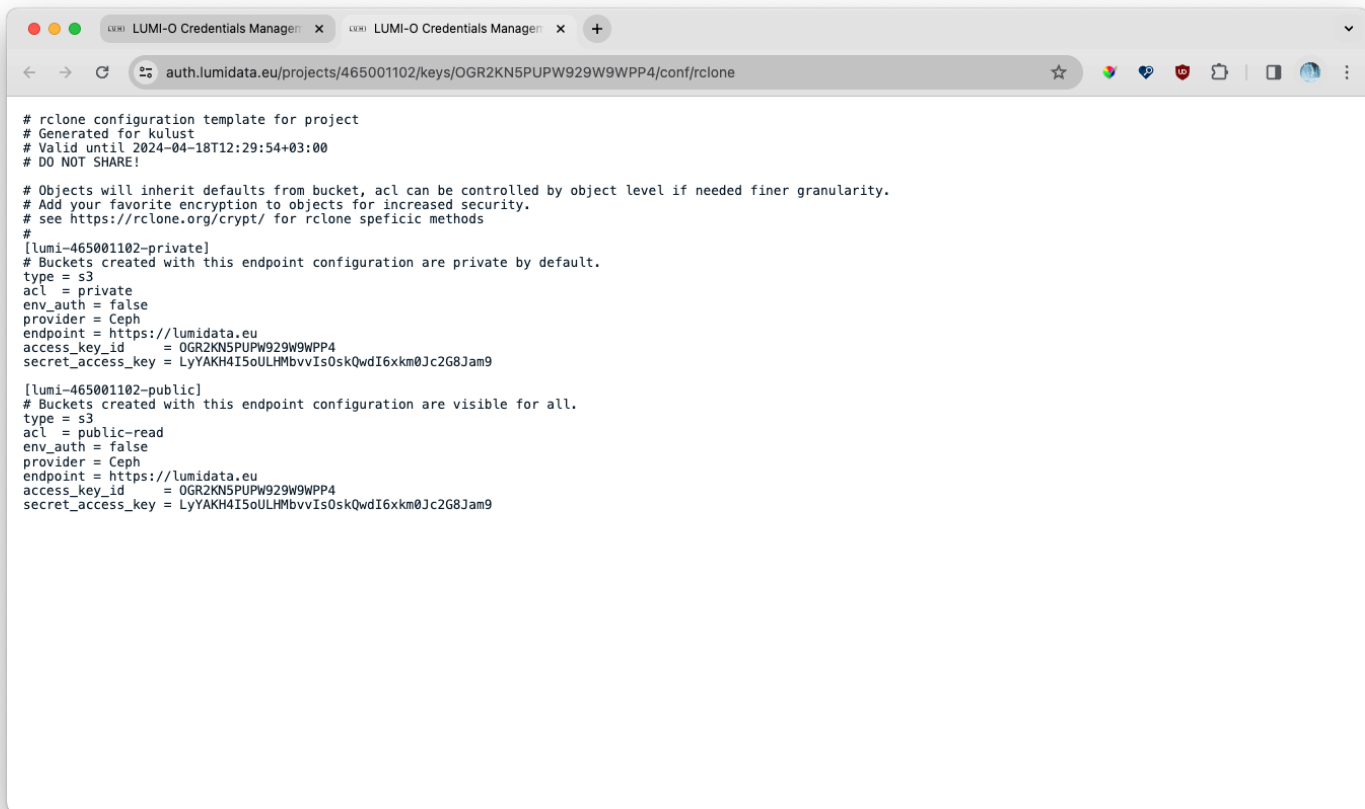
Configuration templates

Select configuration format to generate (opens in a new tab)

- shell
- boto3
- rclone
- s3cmd
- aws

manently disable all connections where this key has been he connection

Credential mangement web interface: Tool configuration (2)



```
# rclone configuration template for project
# Generated for kulust
# Valid until 2024-04-18T12:29:54+03:00
# DO NOT SHARE!

# Objects will inherit defaults from bucket, acl can be controlled by object level if needed finer granularity.
# Add your favorite encryption to objects for increased security.
# see https://rclone.org/crypt/ for rclone specific methods
#
[[lumi-465001102-private]
# Buckets created with this endpoint configuration are private by default.
type = s3
acl = private
env_auth = false
provider = Ceph
endpoint = https://lumidata.eu
access_key_id = OGR2KN5PUPW929W9WPP4
secret_access_key = LyYAKH4I5oULHMbvvis0skQwdI6xkm0Jc2G8Jam9

[[lumi-465001102-public]
# Buckets created with this endpoint configuration are visible for all.
type = s3
acl = public-read
env_auth = false
provider = Ceph
endpoint = https://lumidata.eu
access_key_id = OGR2KN5PUPW929W9WPP4
secret_access_key = LyYAKH4I5oULHMbvvis0skQwdI6xkm0Jc2G8Jam9
```

Credential management via OOD

CLI tool configuration on LUMI: lumio-conf

- On LUMI, you can use `lumio-conf` to configure `rclone` and `s3cmd`
 - Need to load the `lumio` module which also provides `rclone`, `s3cmd` and `restic`
 - Will ask for data from the “Access key details” screen
 - A future version may be more automatic
 - The `rclone` configuration differs from the one generated via the web interface
- Generate the configuration snippets via the web interface
 - E.g., for `rclone`: copy manually to `~/.config/rclone/rclone.conf`
 - Can be used to configure tools on your computer also

CLI tool configuration on LUMI: lumio-conf and rclone

- The `rclone` configuration contains two end points
 - With lumio-conf :
 - `lumi-o`: Buckets and objects uploaded to this endpoint will not be publicly accessible
 - `lumi-pub`: Buckets and objects uploaded to this endpoint will be publicly accessible
 - Can have both publicly accessible and not publicly accessible objects in one bucket
 - Web-generated configuration file:
 - `lumi-465001102-private`: Private buckets and objects
 - `lumi-465001102-public`: Public buckets and objects

Policies and ACLs

- Access control is managed through bucket policies and bucket and object access control lists (ACLs)
- Policies is a very powerful but also hard to use mechanism
 - Some information in [the “Advanced usage of LUMI-O” section of the docs](#)
 - And there is also [information in the Ceph manual](#)
 - Can be managed through `s3cmd`
- ACLs apply to individual buckets and objects
 - Can only add rights
 - Useful to make a bucket or object public, or give access to another project, but this is done to individual objects (unless applied recursively)

Policies and ACLs

Examples

- Make a bucket and all objects in it public or private

```
s3cmd setacl --recursive --acl-public s3://bucket/
s3cmd setacl --recursive --acl-private s3://bucket/
```
- Grant or revoke read rights to a bucket

```
s3cmd setacl --acl-grant='read:465000000$465000000' s3://bucket
s3cmd setacl --acl-revoke='read:465000000$465000000' s3://bucket
```

 - Note the use of single quotes to make sure that \$465000000 is not interpreted as a variable name!
 - And similarly to objects
- Check the ACL and other information of a bucket or object

```
s3cmd info s3://2day-20241210
s3cmd info s3://2day-20241210/img/LUMI-2day-20241210-10-ObjectStorage/Title.png
```

Some tips & tricks

- When using the `rclone` command line tool, it is possible to throttle the speed for many commands with the `--bwlimit` command line option
 - May be needed if you upload from home over a very bandwidth-limited connection

Questions?

