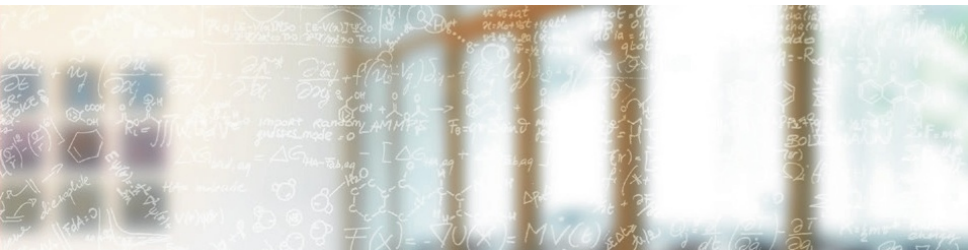




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# FirecREST - a Web API for HPC at CSCS

CSCS User Lab Day - Meet the Swiss National Supercomputing Centre

Theofilos Manitaras - ETH Zurich/CSCS

September 9, 2019

# FirecREST a Web API for HPC at CSCS



- FirecREST in a Nutshell
- Microservice Architecture
- FirecREST Workflow
- API Endpoints & Demo client
- Why FirecREST?





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# FirecREST in a Nutshell

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# FirecREST Trivia



Firecrest in nature

# What is FirecREST?

FirecREST is a RESTful Services Gateway to HPC resources built with a microservices architecture.

- **Gateway to HPC:**

- Identity Access Management (IAM)
- HPC Workload Management
- Data Mover

- **RESTful interfaces:** Architecture abstraction allowing for simple, lightweight and fast applications.

- **Microservices:** Decouple functionalities found in monolithic server architecture.

# FirecREST Motivation

- Improve accessibility of HPC resources to scientific communities.
- Create an interface for the development of domain specific platforms.
- Develop a standard interface to Cray system resources.
- Take advantage of the CSCS Identity and Access Management so that users can use their credentials.



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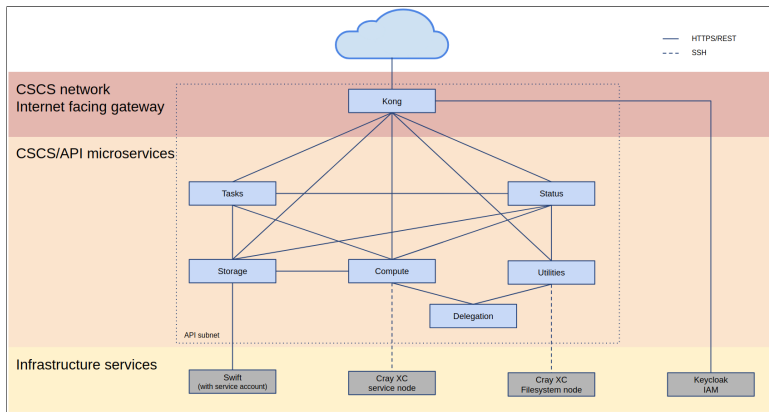
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# Microservice Architecture

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# FirecREST Microservices Overview



FirecREST microservice architecture



# FirecREST Components

## Services

- Kong API gateway
- Compute
- Storage
- Utilities
- Support
  - Tasks
  - Status
  - Delegation

## Core CSCS Service Dependencies

- Workload Manager node
  - Compute
  - Xfer
- Utility node, filesystem utilities
- SWIFT, data transfer staging area
- Keycloak, authentication & authorization

# FirecREST Microservices

- **Kong:** Open-Source microservice API Gateway. Implements and enforces authentication, authorization, traffic control, analytics, logging.
- **Compute:** Non-blocking calls to workload manager for submitting/querying jobs. The service responds with a reference to a temporary task resource tracking the request state.
- **Storage:** Non-blocking calls to high-performance storage services. The service responds with a task reference as above.
- **Utilities:** Fundamental filesystem utilities. All calls are blocking with a timeout.
- **Support:**
  - Tasks: state of tasks
  - Delegation: OIDC token → SSH user-certificate
  - Status: information on services and infrastructure.



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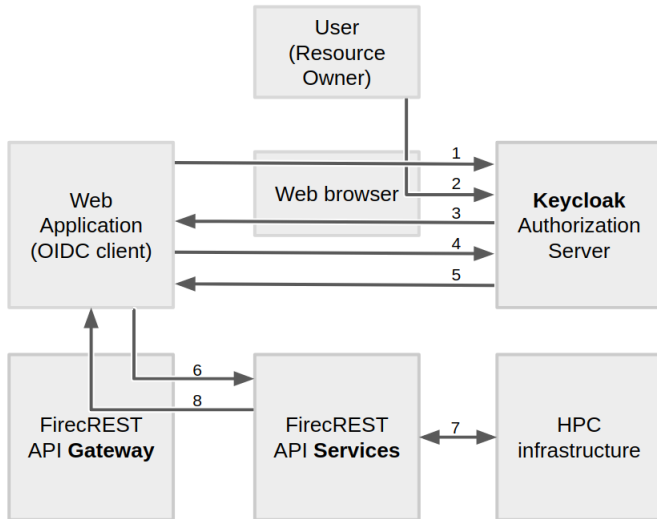
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# FirecREST Workflow

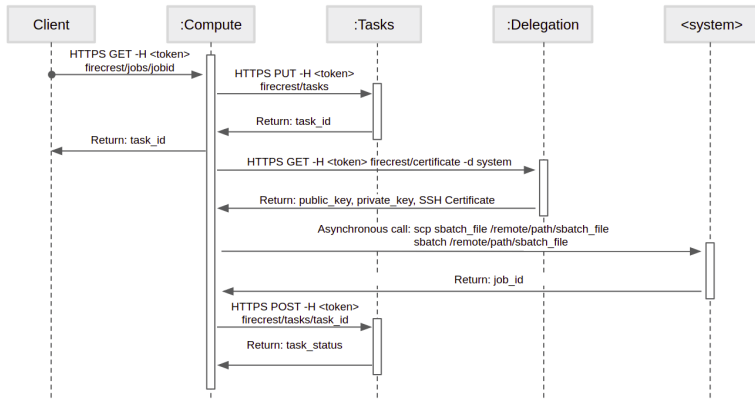
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# Authentication and Authorization

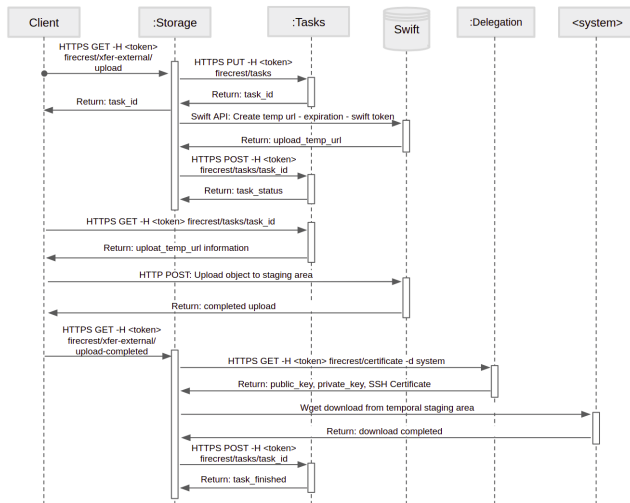


OIDC-based Authentication/Authorization

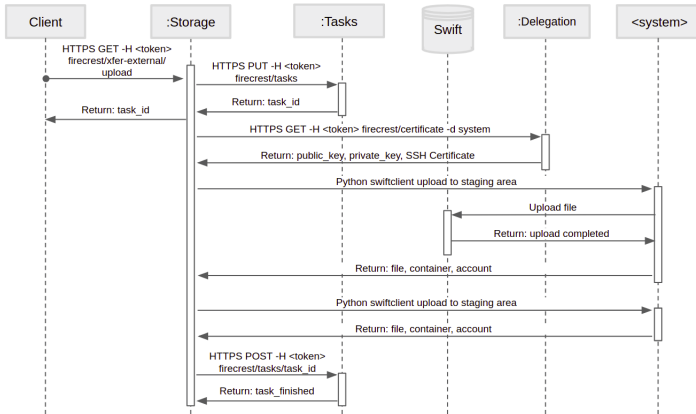
# Job Submission Workflow



# Data Upload Workflow



# Data Download Workflow





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# API Endpoints

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# The FirecREST API

## FirecREST API 0.9.9 QA53

[/firecrest-developers-api.yaml](#)

FirecREST platform, a RESTful Services Gateway to HPC resources, is a high-performance and reusable framework that integrates with existing HPC infrastructure, thus enabling the access to HPC resources to web-enabled services.

FirecREST provides a REST API that defines a set of functions through which developers can interact with using the HTTP/REST protocol architecture. Calls to the REST API received by the services gateway are translated into the appropriate infrastructure requests. Among the most prominent services that FirecREST exposes we find authentication and authorization, system status, file-system access, data mover, execution of parallel jobs, accounting information, etc.

Servers

▾

**Status** Status information of infrastructure and services. >

**Utilities** Basic system utilities. All calls are blocking and low-latency operations, maximum operation duration is limited by a timeout. >

**Compute** Non-blocking calls to workload manager to submit and query jobs. The service responds with a reference to the temporary task resource that tracks the state of the request. >

**Storage** Non-blocking calls to high-performance storage services. The service responds with a reference to the temporary task resource that tracks the state of the request. >

**Tasks** Access status and response of compute and storage tasks. >

## Overview of the FirecREST API

# Status

| Status <small>Status information of infrastructure and services.</small> |                                | ▼                       |
|--|--------------------------------|-------------------------|
| GET  | /status/services               | List of services        |
| GET  | /status/services/{servicename} | Get service information |
| GET  | /status/systems                | List of systems         |
| GET  | /status/systems/{machinename}  | Get system information. |

The **Status** endpoints

# Displaying the status of the systems

| Home <span>Log Out</span>             |           |
|---------------------------------------|-----------|
| Displaying status of the CSCS systems |           |
| System                                | Status    |
| dom                                   | available |
| daint                                 | available |
|                                       |           |

System status using endpoint: `/status/systems/{machinename}`

# Utilities

| Utilities <small>Basic system utilities. All calls are blocking and low-latency operations, maximum operation duration is limited by a timeout.</small> |                                   |   | ▼ |
|---|-----------------------------------|---|---|
| GET   | /utilities/{machinename}/ls       | List directory contents                   |   |
| POST  | /utilities/{machinename}/mkdir    | Creates a directory                       |   |
| POST  | /utilities/{machinename}/rename   | Rename/move a file, directory, or symlink |   |
| POST  | /utilities/{machinename}/chmod    | Change file mode bits                     |   |
| POST  | /utilities/{machinename}/chown    | Change file owner and group               |   |
| GET   | /utilities/{machinename}/file     | determine file type                       |   |
| POST  | /utilities/{machinename}/symlink  | Create a symlink                          |   |
| GET   | /utilities/{machinename}/download | Download a small file                     |   |
| POST  | /utilities/{machinename}/upload   | Uploads a small file                      |   |

## The **Utilities** endpoints

# Upload small file

[Home](#)[Log Out](#)

In this page you can upload your files to CSCS

**destination**

/users/manitart/my\_dir

**file**

my\_file

**machine**

daint ▾

Upload a small file using: `/utilities/{machinename}/upload`

# List User Files

| Home <span>Log Out</span>                            |       |
|--|-------|
| Listing files for /users/manitart/reframe_dev_public |       |
| Name   | Size  |
| CONTRIBUTING.md                                      | 423   |
| Jenkinsfile  | 9708  |
| LICENSE  | 1543  |
| README.md  | 4227  |
| bin  | 4096  |
| ci-scripts   | 4096  |
| config   | 4096  |
| cscs-checks  | 4096  |
| docs   | 4096  |
| reframe  | 4096  |
| reframe.log  | 60735 |
| reframe.py   | 101   |
| requirements.txt                                     | 34    |
| setup.cfg  | 68    |
| setup.py   | 1045  |
| test_reframe.py                                      | 769   |
| tutorial   | 4096  |

List user directory using: `/utilities/{machinename}/ls`

# Compute

|   |  |
|---|--|
| <b>Compute</b> Non-blocking calls to workload manager to submit and query jobs. The service responds with a reference to the temporary task resource that tracks the state of the request. <span>✓</span> |  |
| POST  | /jobs/{machine} Submit Job                               |
| GET   | /jobs/{machine} Retrieves information from all jobs      |
| GET   | /jobs/{machine}/{jobid} Retrieves information from a job |
| DELETE  | /jobs/{machine}/{jobid} Delete Job                       |
| GET   | /jobs/{machine}/acct Job account information             |

The **Compute** endpoints

# Submitting a Job

[Home](#)[Log Out](#)

In this page you can upload sbatch files to CSCS

file

simple\_sbatch.sh

machine

daint

Submit an sbatch script using: `/jobs/{machine}`



# Monitor active jobs

| Home <span>Log Out</span> |         |                |
|---------------------------|---------|----------------|
| Listing Active Jobs       |         |                |
| Jobid                     | State   | Name           |
| 16427851                  | PENDING | FirecREST_test |
| 16427854                  | PENDING | FirecREST_test |
| 16427861                  | PENDING | FirecREST_test |

Monitor status of active jobs using: `/jobs/{machine}`

# Storage

| Storage |   | ▼ |
|---------|---|---|
| GET     | /storage/xfer-internal/rsync rsync  |   |
| GET     | /storage/xfer-internal/mv move (rename) files   |   |
| GET     | /storage/xfer-internal/cp copy files and directories  |   |
| GET     | /storage/xfer-internal/rm remove files or directories   |   |
| GET     | /storage/xfer-external/upload Upload a file   |   |
| GET     | /storage/xfer-external/upload-finished/{task_id} Upload to Object Storage finished notification |   |
| GET     | /storage/xfer-external/download Download a file   |   |

## The **Storage** endpoints

# Upload a large file

[Home](#)[Log Out](#)

## In this page you can upload your files to CSCS

Enter the target path

Enter the source path

Upload file using: `/storage/xfer-external/upload`

# Tasks

| Tasks Access status and response of compute and storage tasks. <span>▼</span> |   |
|---|---|
| GET   | /tasks/tasks returns all tasks            |
| PUT   | /tasks/tasks Creates a task               |
| GET   | /tasks/tasks/{id} task status information |
| POST  | /tasks/tasks/{id} Updates a task          |
| DELETE  | /tasks/tasks/{id} Delete task             |

## The **Tasks** endpoints

# Displaying FirecREST tasks

| Home Log Out                     |   |
|----------------------------------|---|
| Displaying FirecREST tasks       |   |
| Task ID                          | Content   |
| 001b4db8c445f85a0526088bec51e0e5 | {'data': 'No queue slurm jobs', 'description': 'Finished sucessfully', 'hash_id': '001b4db8c445f85a0526088bec51e0e5', 'last_modify': '2019-08-26T13:20:58', 'service': None, 'status': '200', 'user': 'manitart'}   |
| 03ed1d0c651cd23e85f34e4321e42a31 | {'data': {'hash_id': '03ed1d0c651cd23e85f34e4321e42a31', 'msg': 'curl -i<br>-X POST -F max_file_size=5368709120 -F max_file_count=1 -F expires=1569592916 -F<br>-F redirect= -F file=@/home/manitart/my_large_file', 'system': '127.0.0.1:2222', 'target': '/users/manitart/my_dir', 'user': 'manitart'}, 'last_modify': '2019-08-26T13:20:58', 'service': None, 'status': '111', 'user': 'manitart'} |
| 03fade1dd511afc1067feb6b00dbe5b  | {'data': 'Submitted batch job 764657', 'description': 'Finished sucessfully', 'hash_id': '03fade1dd511afc1067feb6b00dbe5b', 'last_modify': '2019-08-26T13:20:58', 'service': None, 'status': '200', 'user': 'manitart'}   |
| 05f97642c2c7c5b939ab4fcfb2f54760 | {'data': 'No queue slurm jobs', 'description': 'Finished sucessfully', 'hash_id': '05f97642c2c7c5b939ab4fcfb2f54760', 'last_modify': '2019-08-26T13:20:58', 'service': None, 'status': '200', 'user': 'manitart'}   |
| 087460e13635a0abca721792a280f4e2 | {'data': 'No queue slurm jobs', 'description': 'Finished sucessfully', 'hash_id': '087460e13635a0abca721792a280f4e2', 'last_modify': '2019-08-26T13:20:58', 'service': None, 'status': '200', 'user': 'manitart'}   |

Display all tasks using: `/tasks/tasks`



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# Why use FirecREST?

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# FirecREST Advantages

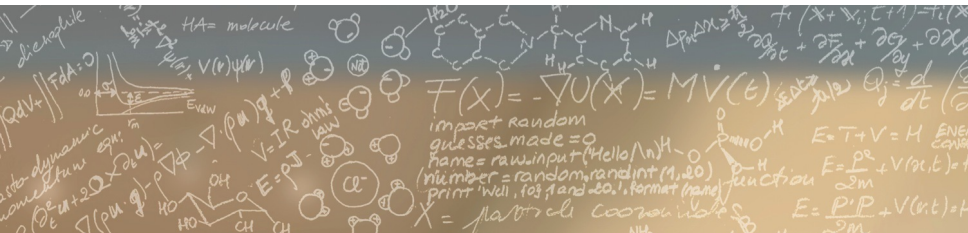
- Common, stable, maintainable API
- Enforce that all API requests are authenticated
- Applications never manipulate user credentials
- Only allow requests from registered applications
- User-managed access permissions per application
- Stateless security module by use of tokens (OIDC)
- Enables managing of execution workloads
- Enables external data transfer from/to HPC filesystems
- Soon to be open-sourced



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**Thank you for your attention.**