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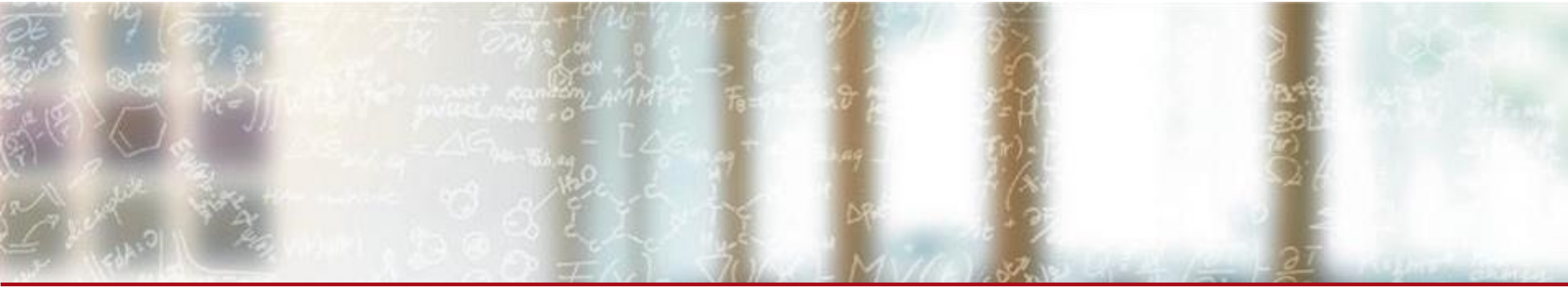

FirecREST: a common interface for HPC and AI workflows

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Introducing FirecREST

FirecREST in a nutshell

- **FirecREST is an open-source web API to access HPC resources**

FirecREST in a nutshell

- **FirecREST is an open-source web API to access HPC resources**

- Standard/common API
  - Abstracts the underlying HPC technology
    - Scheduler
    - Filesystem
    - Storage
  - Based on RESTful design principles (HTTP verbs)

FirecREST in a nutshell

- **FirecREST is an open-source web API to access HPC resources**
- Standard/common API
- Web interface for classic HPC
  - Integrates web standards (OAuth2, REST, OpenAPI, etc.)
  - Accessible via HTTP/HTTPS

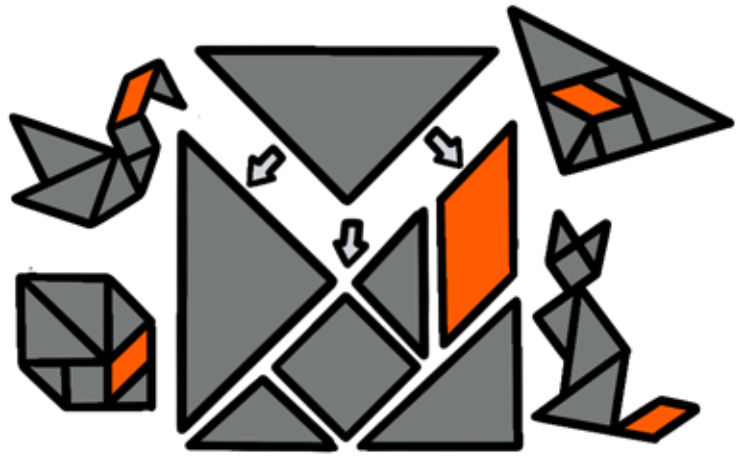
FirecREST in a nutshell

- **FirecREST is an open-source web API to access HPC resources**

- Standard/common API

- Web interface for classic HPC

- Modular and lightweight architecture
  - Extremely lightweight and modern stack
    - Stateless does not require any persistent storage
    - Proxy based architecture with high throughput performance
  - Modules types:
    - Auth modules (Keycloak, GoogleID, Microsoft, Shibboleth, etc.)
    - Scheduler modules (Slurm, openPBS, etc.)
    - Storage modules (S3, Filesystem, Data streamer, etc.)



FirecREST in a nutshell

- **FirecREST is an open-source web API to access HPC resources**
- Standard/common API
- Web interface for classic HPC
- Modular and lightweight architecture
- Authentication and Authorization
  - Integrates with various Identity Providers for authorization
  - Provides granular resource access authorization

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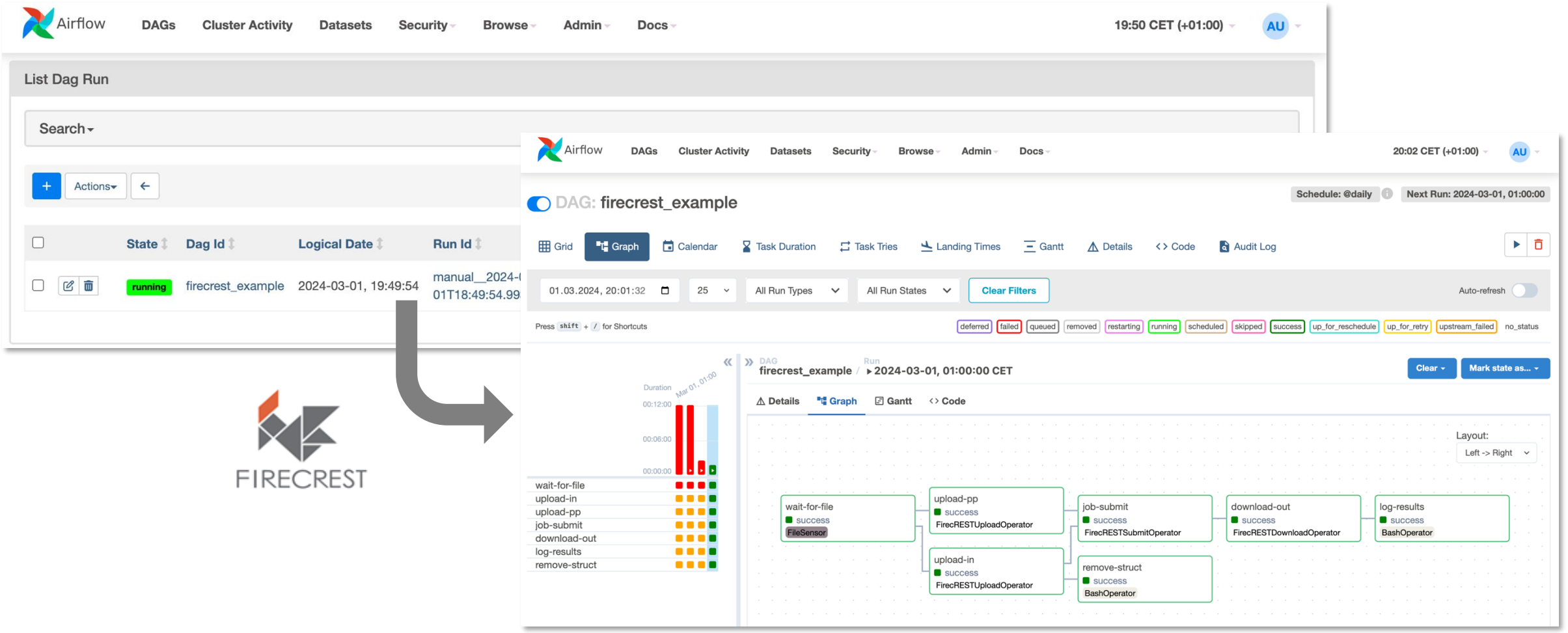
How FirecREST enables modern workflows on HPC

Use Cases - HPC and AI workflows integration

Execute scientific and AI workflows on HPC infrastructure accessing compute and data resources.

- FirecREST
  - Provides secure and reliable access between the workflow engine and the HPC resources
  - Uses standard technology HTTP REST API
  - Facilitate workflows execution across different sites

Example - FirecREST enabled Airflow for AI workflows



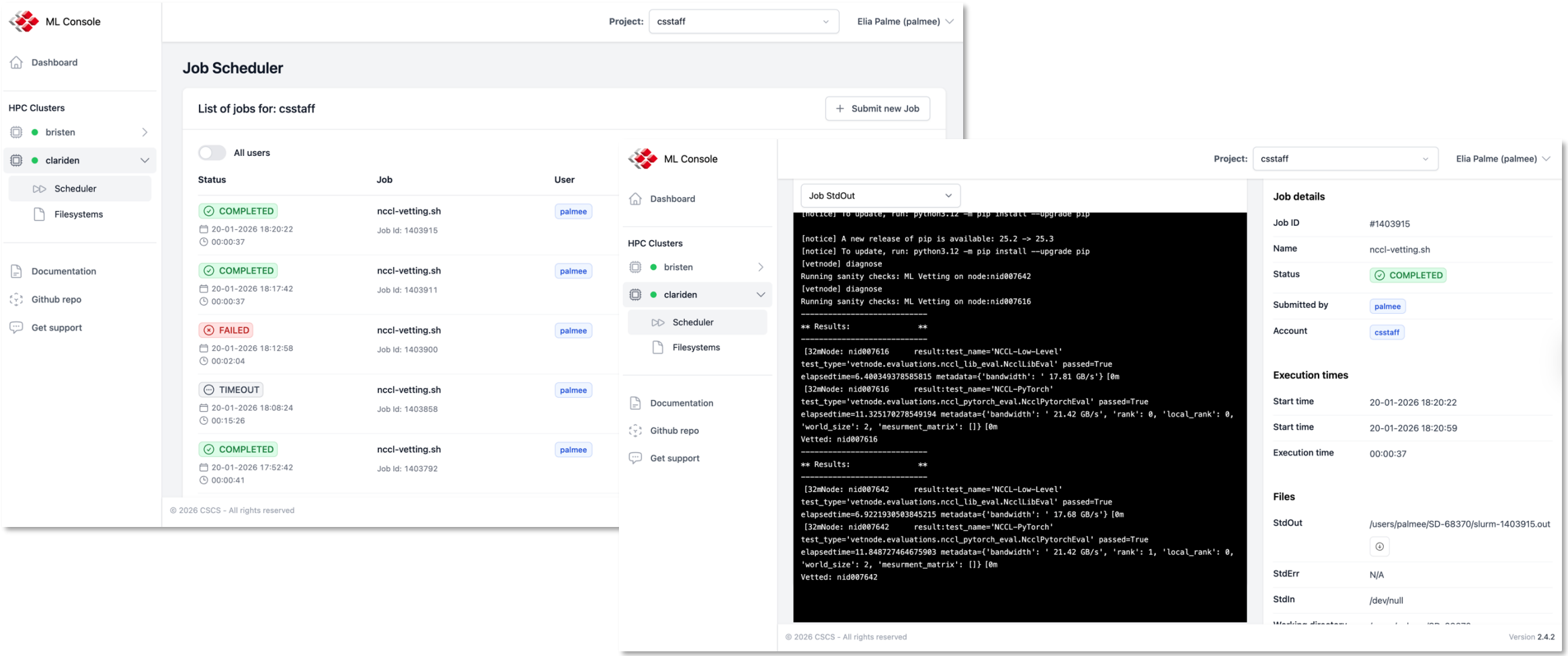
eth-cscs.github.io/firecrest-v2/use_cases/workflow-orchestrator

Use Cases – Custom User Interfaces

Build desktop/web GUI tailored to your HPC/AI workloads

- With FirecREST
  - Enables user authentication over web standards OIDC – OAuth 2.0
  - Provides a secure and reliable channel from web to HPC clusters
  - Provides a simple method (HTTP REST API) to execute jobs
  - **Can be easily integrated into web UIs as it uses standard web technology**

Example – HPC Console (a.k.a. FirecREST-UI)



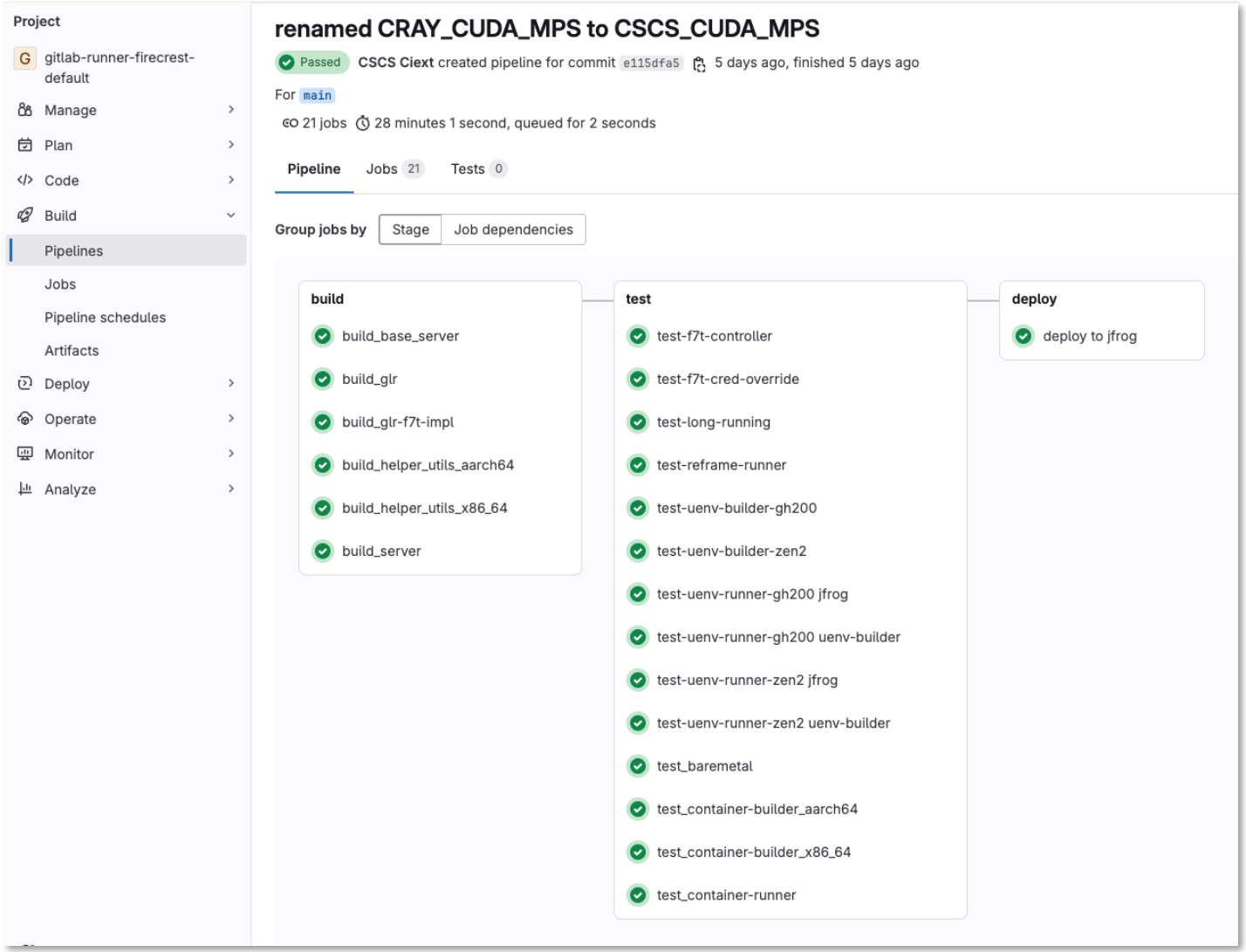
eth-cscs.github.io/firecrest-ui

Use Cases – CI/CD pipelines for HPC

CI/CD pipelines are used to automate deployment of scientific software

- With FirecREST
  - Provides secure OAuth 2.0 authentication (no risk to expose user credentials)
  - Enables a fast and reliable connection into HPC infrastructure
  - **Portable across pipeline engines (GitLab CI, GitHub Actions, etc.) and HPC infrastructures**

Example – FirecREST enabled Alps Image Deployment



eth-cscs.github.io/firecrest-v2/use_cases/CI-pipeline

Use Cases - Quality of Service via Continuous Regression Testing

Execute periodic testing against the HPC infrastructure to validate performance and catch QoS issues.

- With FirecREST
  - Allows remote access to HPC infrastructure over HTTP
    - Regression tests can be executed from laptops, pipelines, cloud, etc.
  - Facilitates tests portability across different sites and infrastructures
  - **Simple development using Python (pyFirecREST)**

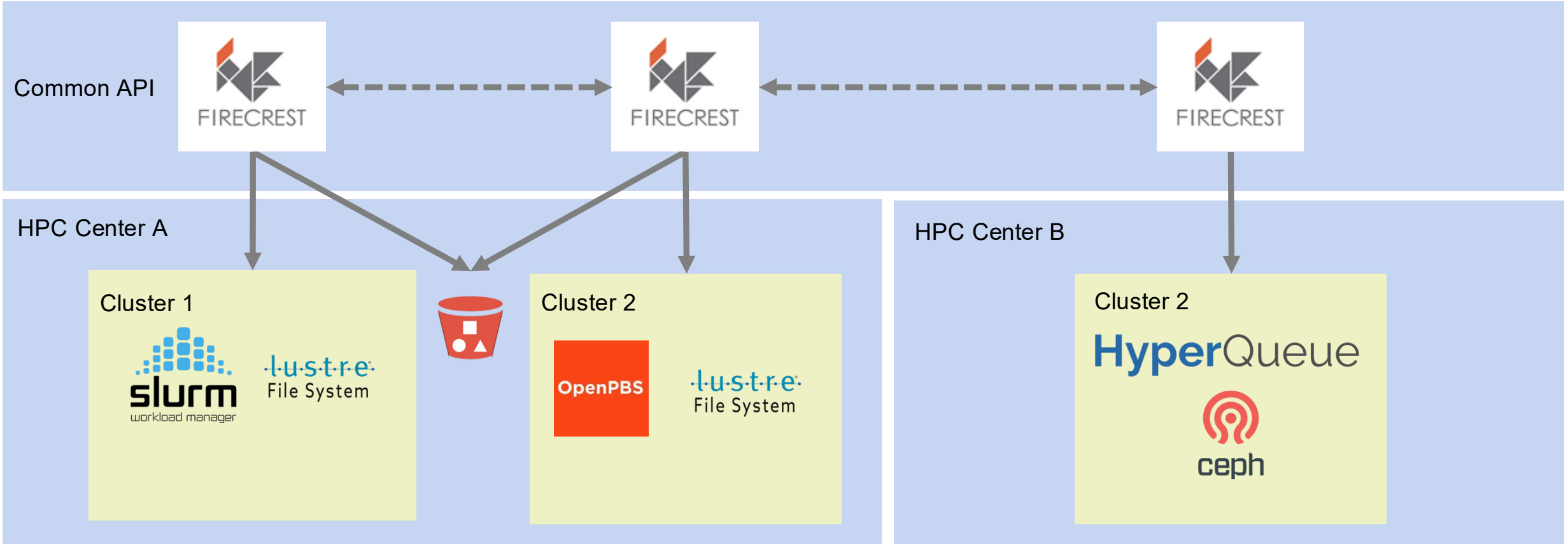
Example – FirecREST enabled ReFrame Regression Testing

```
518 [     FAIL ] (134/137) MemoryOverconsumptionMpiCheck /6a7583af @clariden:nvgpu+PrgEnv-gnu
519 P: cn_avail_memory_from_sysconf: 482 GB (r:0, l:None, u:None)
520 P: cn_max_allocated_memory: 472 GB (r:497, l:-0.05, u:None)
521 ==> test failed during 'performance': test staged in '/builds/ekoutsaniti/clariden-testing-pc
    age/2024-03-05_04-06-05/clariden/nvgpu/PrgEnv-gnu/MemoryOverconsumptionMpiCheck'
522 [     FAIL ] (135/137) MemoryOverconsumptionMpiCheck /6a7583af @clariden:nvgpu+PrgEnv-nvidia
523 P: cn_avail_memory_from_sysconf: 482 GB (r:0, l:None, u:None)
524 P: cn_max_allocated_memory: 471 GB (r:497, l:-0.05, u:None)
525 ==> test failed during 'performance': test staged in '/builds/ekoutsaniti/clariden-testing-pc
    age/2024-03-05_04-06-05/clariden/nvgpu/PrgEnv-nvidia/MemoryOverconsumptionMpiCheck'
526 [       OK ] (136/137) MemoryOverconsumptionMpiCheck /6a7583af @clariden:amdgpu+PrgEnv-cray
527 P: cn_avail_memory_from_sysconf: 457 GB (r:0, l:None, u:None)
528 P: cn_max_allocated_memory: 484 GB (r:497, l:-0.05, u:None)
529 [       OK ] (137/137) MemoryOverconsumptionMpiCheck /6a7583af @clariden:amdgpu+PrgEnv-gnu
530 P: cn_avail_memory_from_sysconf: 465 GB (r:0, l:None, u:None)
531 P: cn_max_allocated_memory: 484 GB (r:497, l:-0.05, u:None)
532 [----------] all spawned checks have finished
533 [==========] Retrying 1 failed check(s) (retry 1/2)
534 [----------] start processing checks
535 [ RUN      ] MemoryOverconsumptionMpiCheck /6a7583af @clariden:nvgpu+PrgEnv-gnu
536 [ RUN      ] MemoryOverconsumptionMpiCheck /6a7583af @clariden:nvgpu+PrgEnv-nvidia
537 [       OK ] (1/2) MemoryOverconsumptionMpiCheck /6a7583af @clariden:nvgpu+PrgEnv-gnu
538 P: cn_avail_memory_from_sysconf: 480 GB (r:0, l:None, u:None)
539 P: cn_max_allocated_memory: 473 GB (r:497, l:-0.05, u:None)
```

FirecREST enables Federation

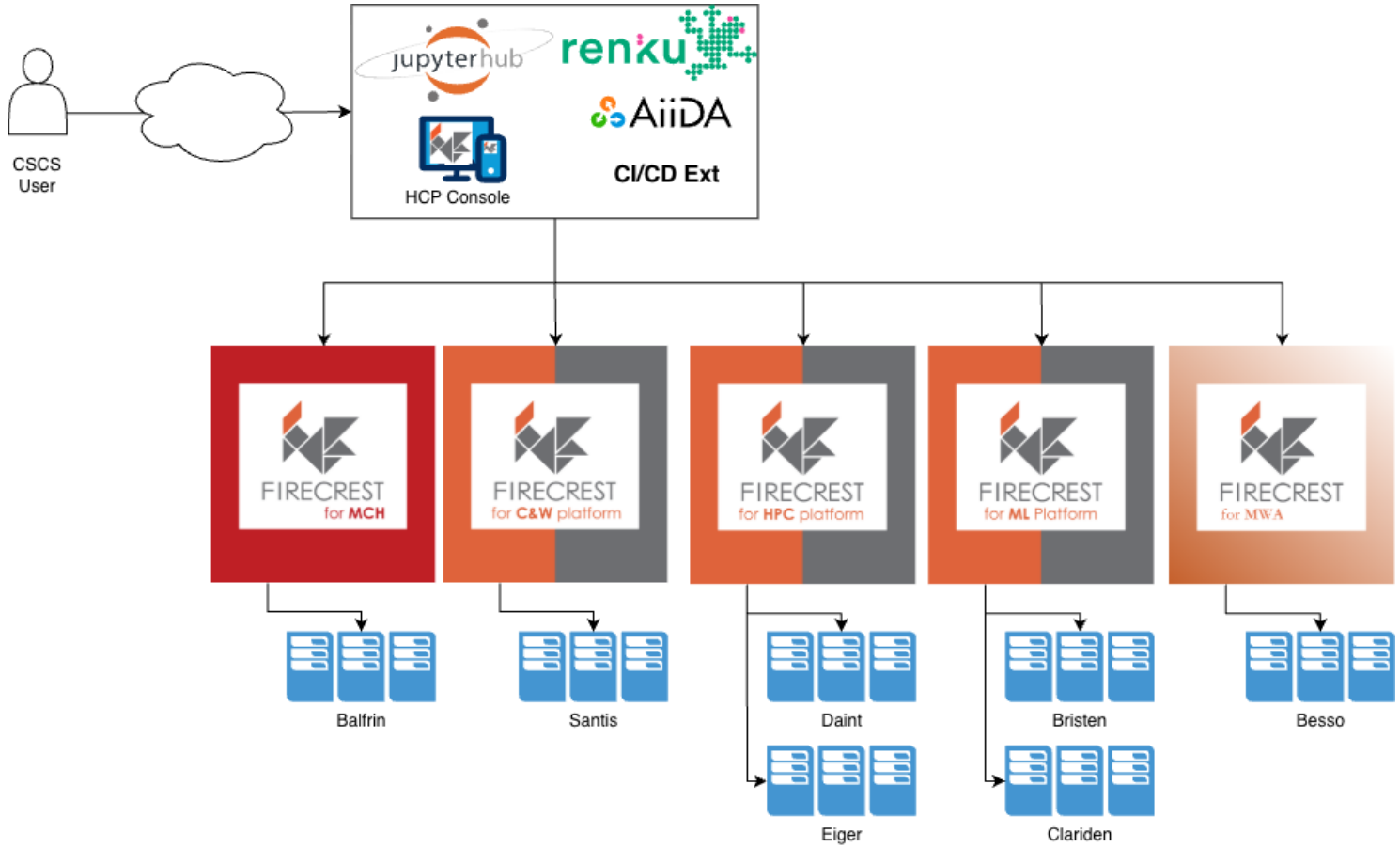
Federation with FirecREST

FirecREST provides a standardized interface across different sites and set of HPC technologies.



Example – FirecREST provides a common interface for Alps

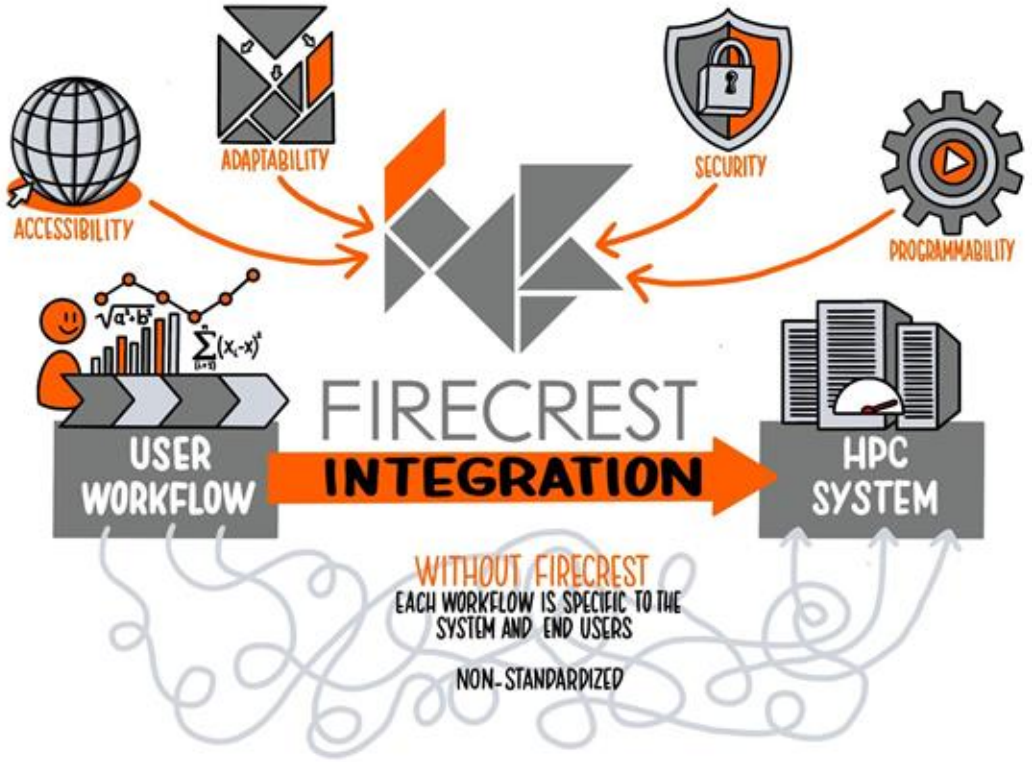
- Alps serves diverse AI, Climate, and HPC workflows from research and industry
- FirecREST is a key interface of the 4 main platforms and their exposed services



Conclusions

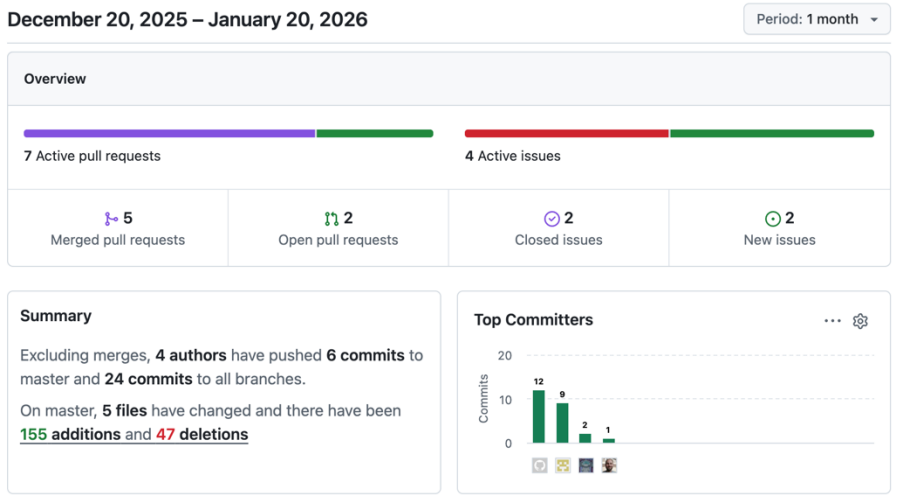
Conclusions

- FirecREST abstracts HPC technologies providing a standardized interface
- FirecREST acts as a proxy enabling web access to HPC infrastructures
- FirecREST enables HPC infrastructure federations across sites for AI and HPC workflows
- FirecREST's modern design, built on widely adopted standards and a modular architecture, enables easy extensibility



Links and references

- More on FirecREST
  - API Reference: eth-cscs.github.io/firecrest-v2/openapi
  - **FirecREST: github.com/eth-cscs/firecrest-v2**
  - pyFirecREST: github.com/eth-cscs/pyfirecrest
  - FirecREST Web UI: github.com/eth-cscs/firecrest-ui
  - Join our community on Slack: firecrest-community.slack.com
  - Contact us: firecrest@cscs.ch



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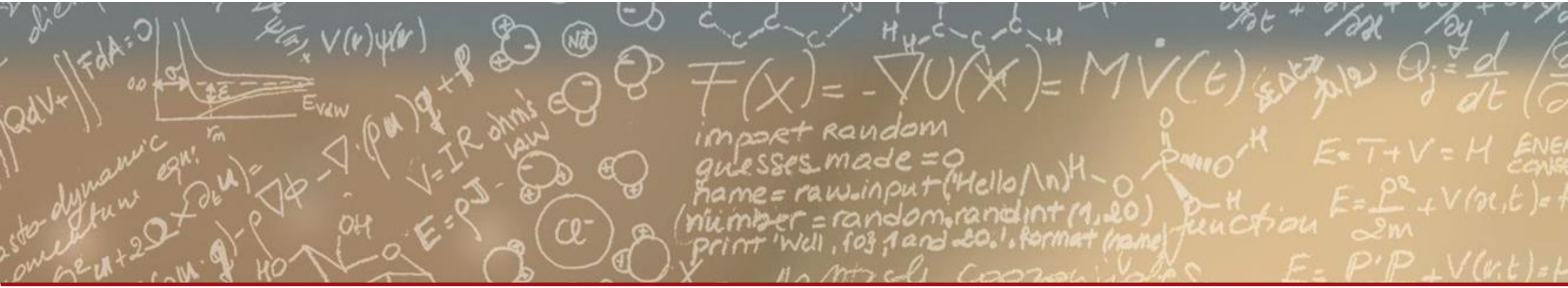
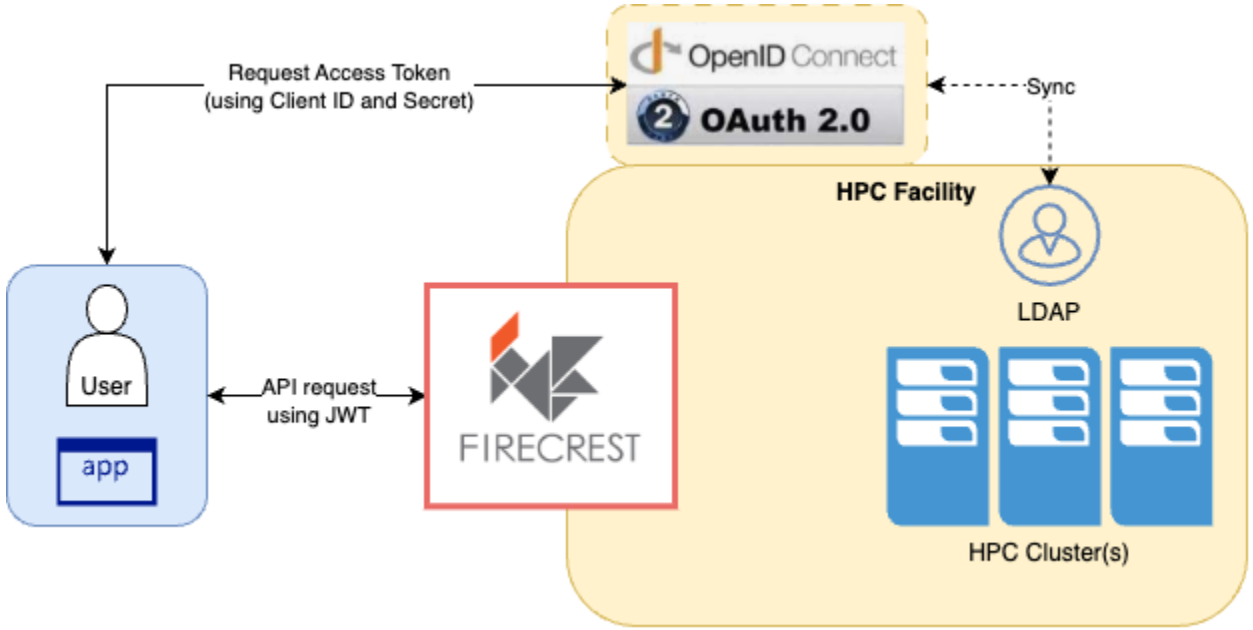


Thank you for your attention.

Q&A Tech Deep Dive

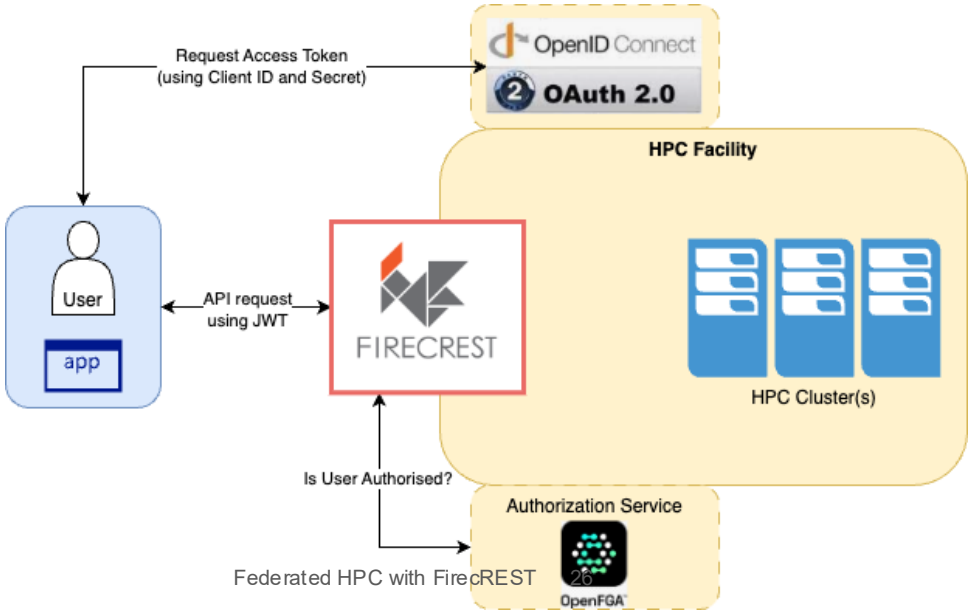
FirecREST Deep Dive

- Authentication
  - AuthN relies on an OpenID Connect server (OIDC) - OAuth2 protocol
  - FirecREST trusts in access token from trusted sources
  - JSON Web Tokens (JWT) standard is used as access tokens



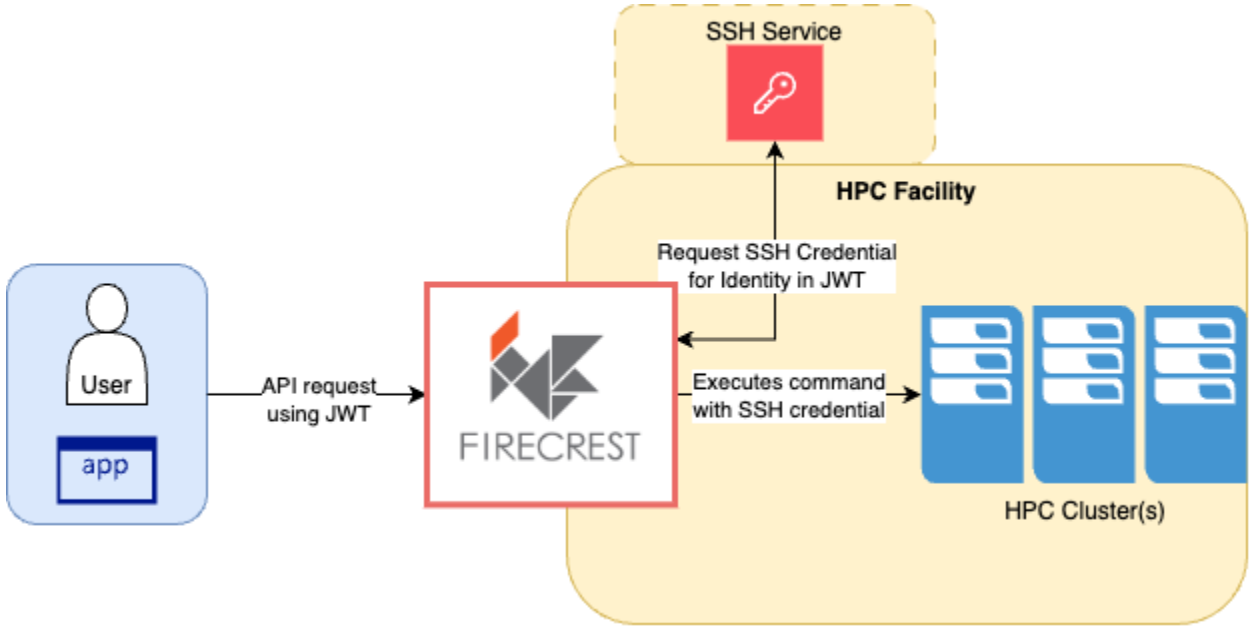
FirecREST Deep Dive

- Authorization
  - FirecREST-v2 provides interface for Authorization
  - Currently provides plugins for OpenFGA, an authorization service based in ReBAC (Relationship Based Access Control)
  - JWT scopes can be used to limit access
  - The idea is to limit the use of endpoints depending on the system or resources the user has access to



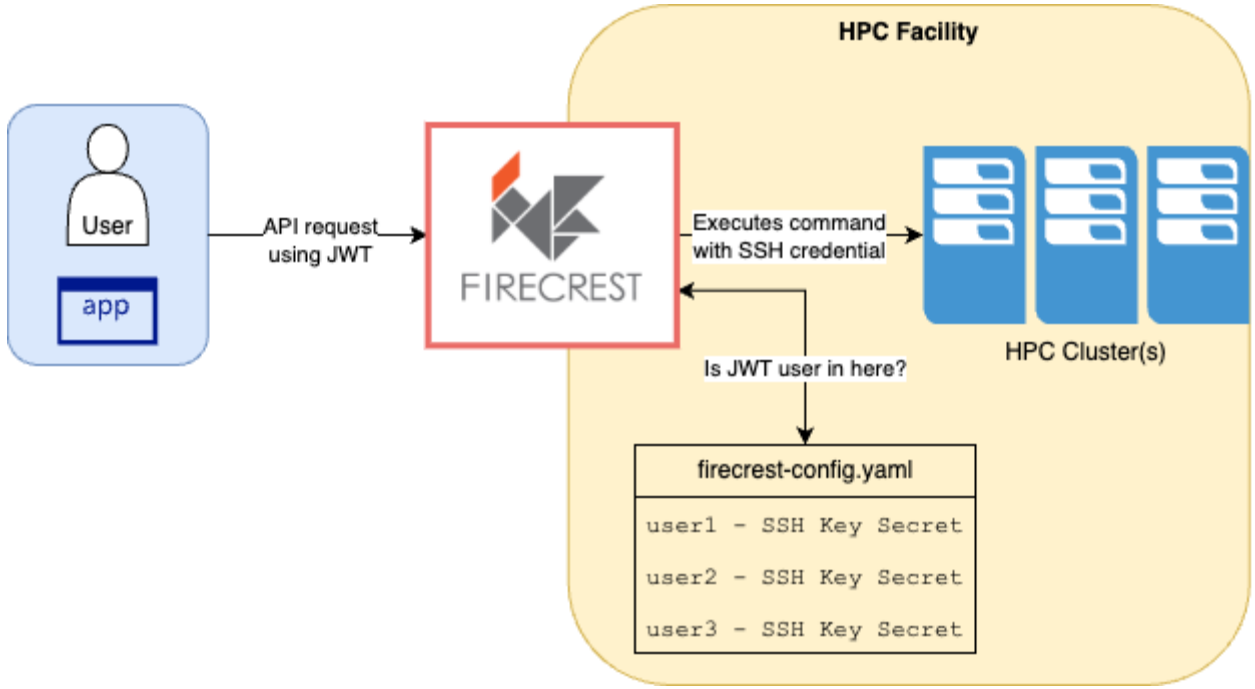
FirecREST Deep Dive

- Command execution
  - FirecREST translate JWT into **user credentials** for HPC systems
  - The SSH Service Adapter provides an abstraction to use the bundled CSCS SSH Service or any type of JWT-to-SSH service



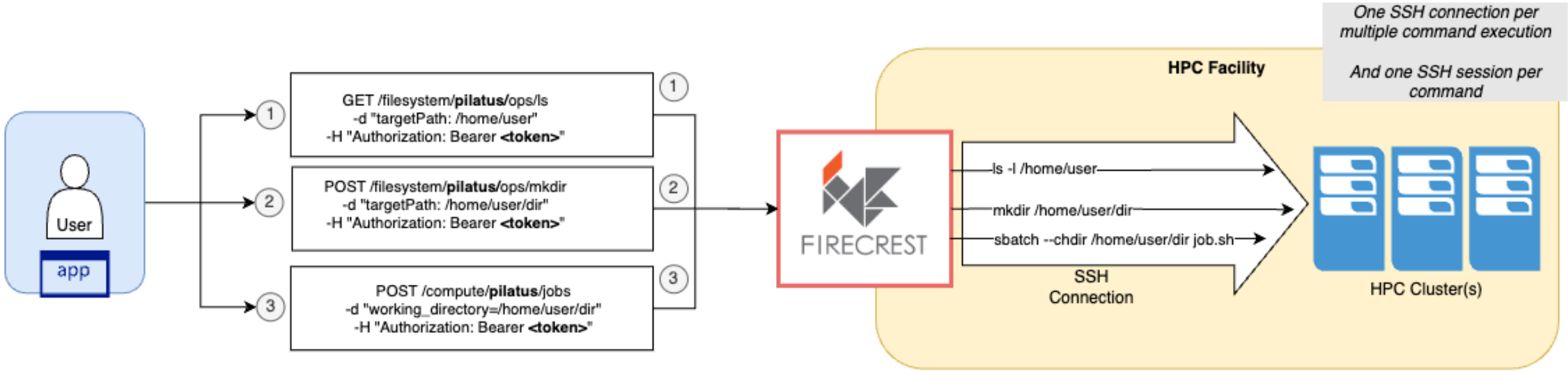
FirecREST Deep Dive

- Command execution
  - FirecREST translate JWT into **user credentials** for HPC systems
  - Using a user-SSH key list (not ideal, but a workaround)



FirecREST Deep Dive

- SSH Connection Pool
  - Needs to adjust the MaxSession setting in SSH Config



FirecREST Deep Dive

- External Data Transfers
  - FirecREST uses S3 Service to decouple data transfer channel from API
  - Data is staged for download using the Workload Scheduler