



A fully configurable HPC web portal for managing Slurm jobs

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Slurm User Group SLUG'19
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We will talk about...

1

Context of the projects

2

XCS - eXtreme factory Computing Studio

3

BEM - Bull Efficiency Manager

4

Conclusion and future work

1

Context of the projects

Bull/Atos HPC & AI Software R&D

- ▶ Our division, Atos BDS (Big Data & Security) is in charge of developing supercomputing hardware and middleware.
- ▶ Our domains of interests: HPC, AI and Quantum simulations.
- ▶ User experience (UX) is extremely important
- ▶ Security is critical in all our activities (and those of our clients)
- ▶ We contribute to Slurm community and integrate Slurm in our HPC stack for more than 10 years

2

XCS

eXtreme factory

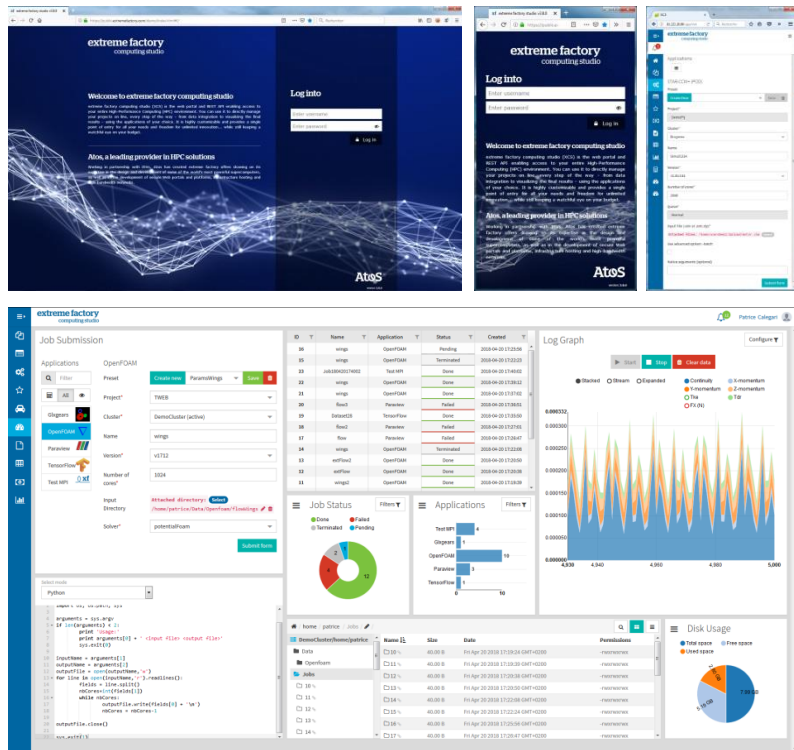
Computing Studio

Extreme factory Computing Studio v3 (XCS3)

Introduction

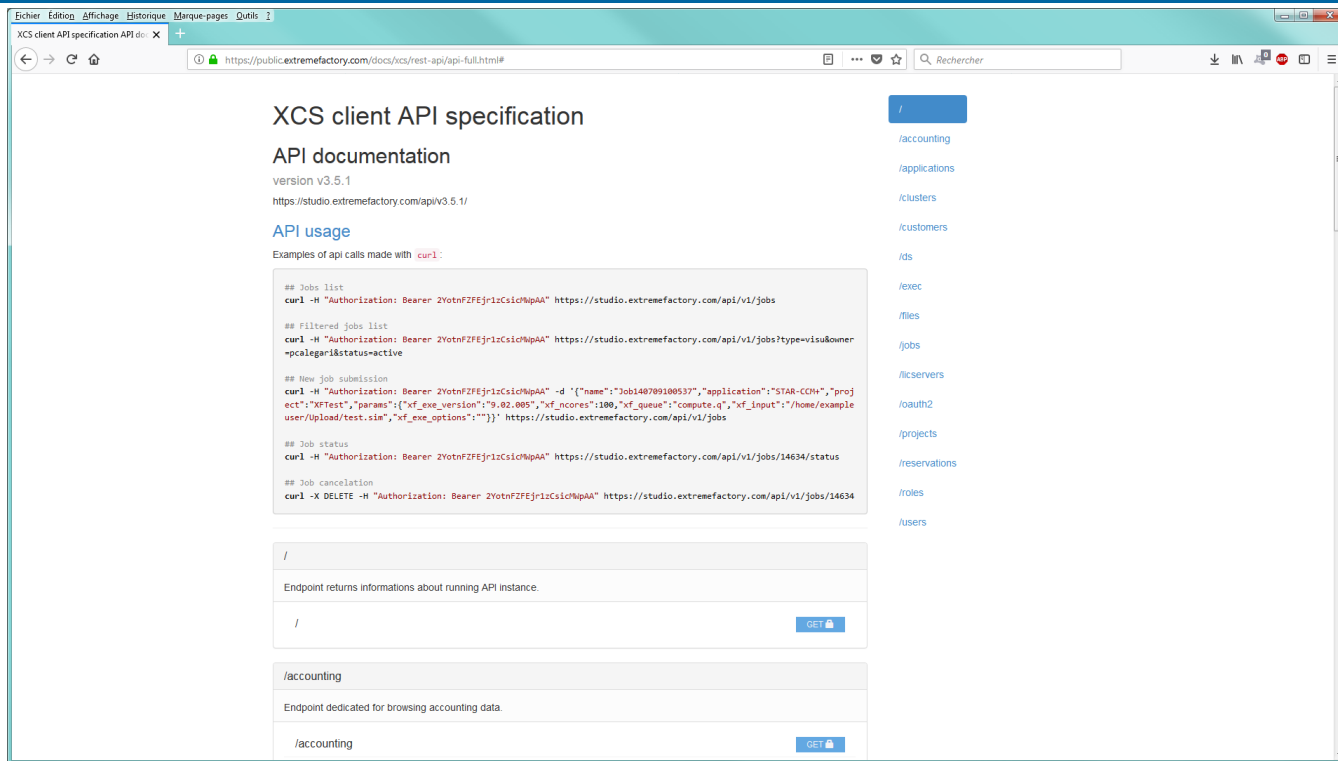
- ▶ **Modular HPC, AI & Quantum portal**
 - as-a-Service cornerstone application,
 - supports **Slurm** (and other schedulers)
 - Role Based Access Control (RBAC)
 - supports AD, LDAP (with Kerberos)
 - XCS = REST API service + GUI
- ▶ **Fully customizable user interface**
 - Responsive Web Design (RWD) GUI
 - Single Page Application (SPA) with configurable dashboards: layout, components, languages, themes

Latest release: XCS 3.8.0 (April 5, 2019)



XCS REST API

<https://public.extremefactory.com/demo/api/doc/api-full.html>



The screenshot shows a web browser displaying the 'XCS client API specification' page. The page title is 'XCS client API specification' and the subtitle is 'API documentation'. The version is 'version v3.5.1' and the URL is 'https://studio.extremefactory.com/api/v3.5.1/'. The page is titled 'API usage' and provides examples of API calls made with 'curl'. The examples include listing jobs, filtering jobs, submitting a new job, checking job status, and canceling a job. The page also features a sidebar with a list of API endpoints: /accounting, /applications, /clusters, /customers, /ids, /exec, /files, /jobs, /jobservers, /oauth2, /projects, /reservations, /roles, and /users. The main content area shows the details for the / endpoint, including a description 'Endpoint returns informations about running API instance.' and a 'GET' button. Below this, the details for the /accounting endpoint are shown, including a description 'Endpoint dedicated for browsing accounting data.' and a 'GET' button.

XCS client API specification

API documentation

version v3.5.1

<https://studio.extremefactory.com/api/v3.5.1/>

API usage

Examples of api calls made with `curl`:

```
## Jobs list
curl -H "Authorization: Bearer 2YotnFZFEjr1zCsicMp4A" https://studio.extremefactory.com/api/v1/jobs

## Filtered jobs list
curl -H "Authorization: Bearer 2YotnFZFEjr1zCsicMp4A" https://studio.extremefactory.com/api/v1/jobs?type=visualowner=pcallegari&status=active

## New job submission
curl -H "Authorization: Bearer 2YotnFZFEjr1zCsicMp4A" -d '{"name":"Job140709100533","application":"STAB-COH","project":"XFTest","params":{"xf_exe_version":"9.02.005","xf_ncores":1200,"xf_queue":"compute.q","xf_input":"/home/example/user/Upload/test.sim","xf_exe_options":""}}' https://studio.extremefactory.com/api/v1/jobs

## Job status
curl -H "Authorization: Bearer 2YotnFZFEjr1zCsicMp4A" https://studio.extremefactory.com/api/v1/jobs/14634/status

## Job cancellation
curl -X DELETE -H "Authorization: Bearer 2YotnFZFEjr1zCsicMp4A" https://studio.extremefactory.com/api/v1/jobs/14634
```

/

Endpoint returns informations about running API instance.

/

GET

/accounting

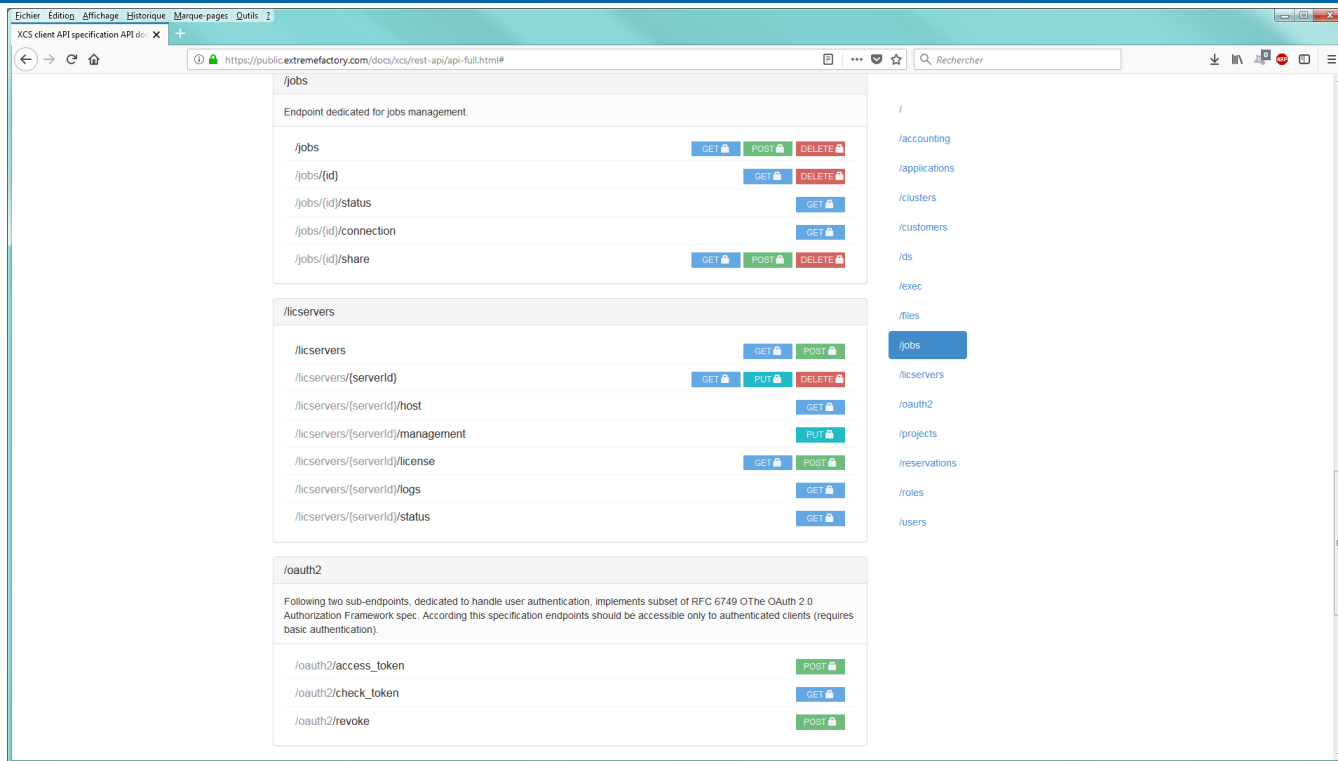
Endpoint dedicated for browsing accounting data.

/accounting

GET

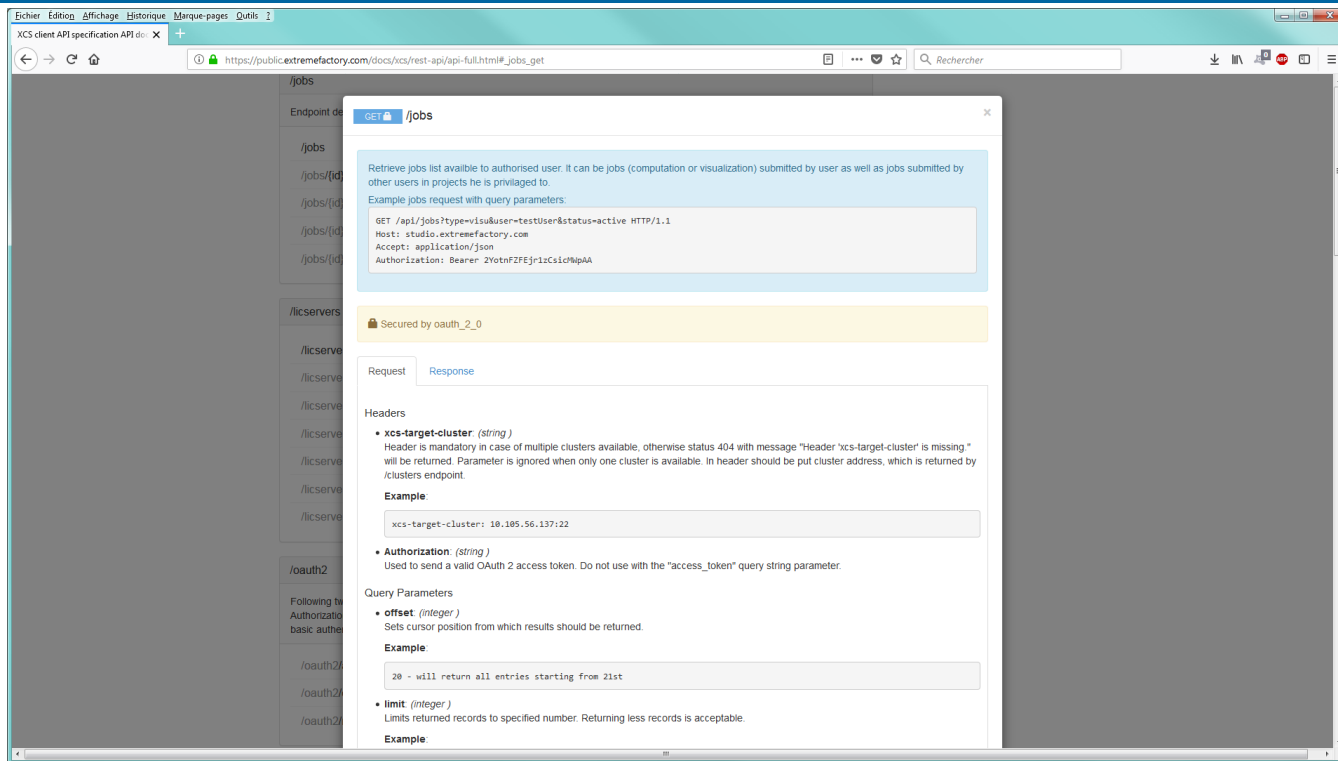
XCS REST API

<https://public.extremefactory.com/demo/app/api/doc/api-full.html>



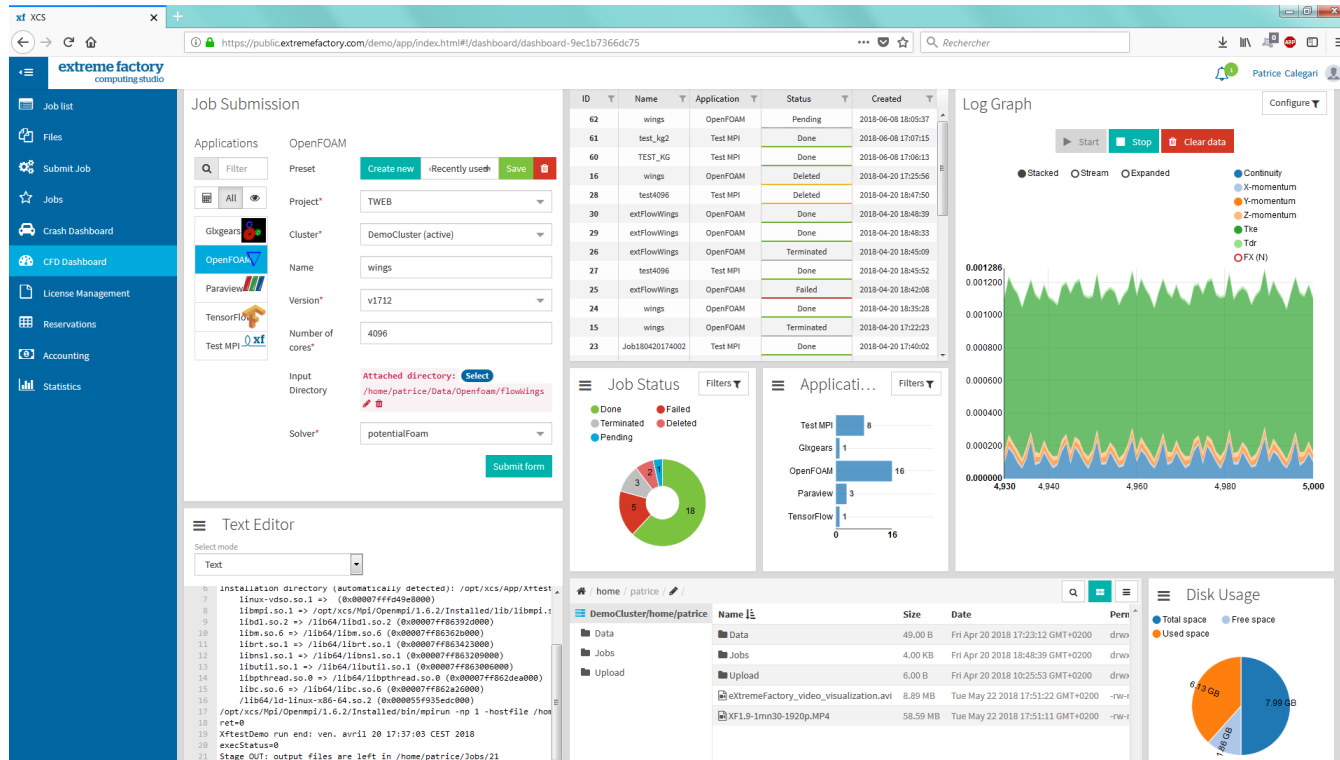
XCS REST API

<https://public.extremefactory.com/demo/app/api/doc/api-full.html>



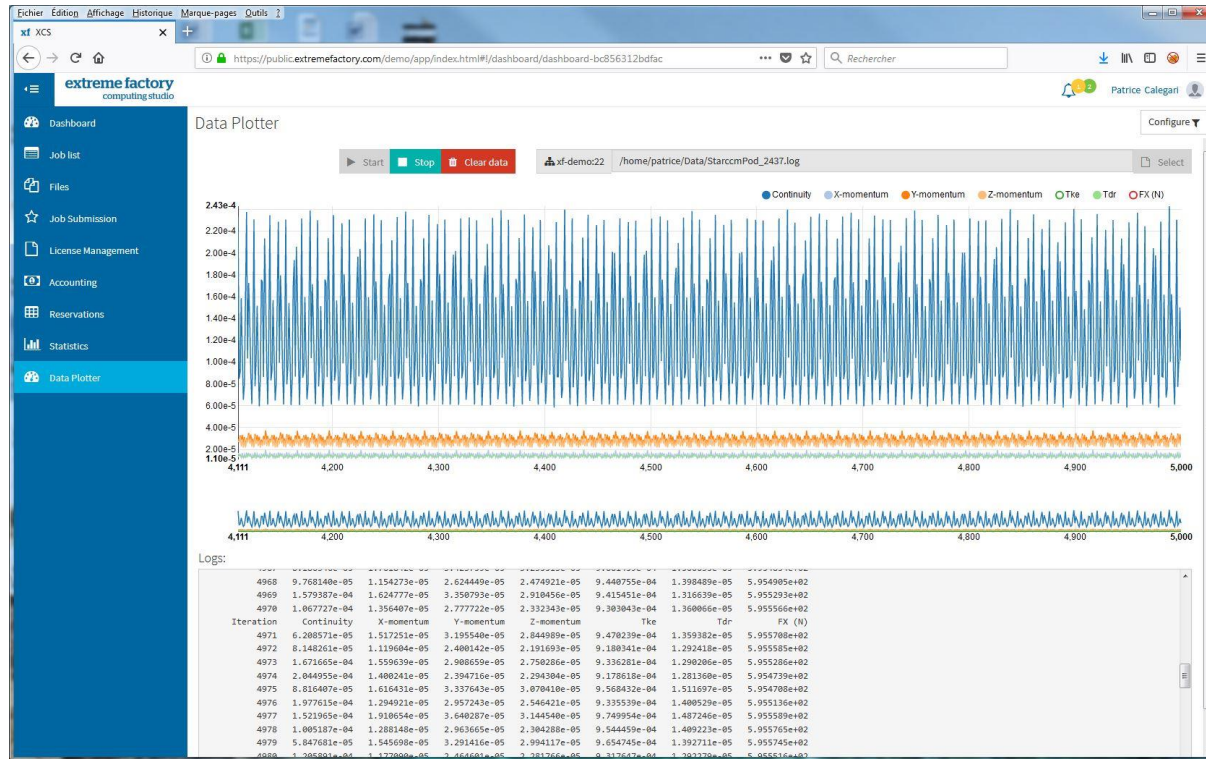
XCS user dashboard

Example 1: 8 components



XCS user dashboard

Example 2: 1 component



XCS user dashboard

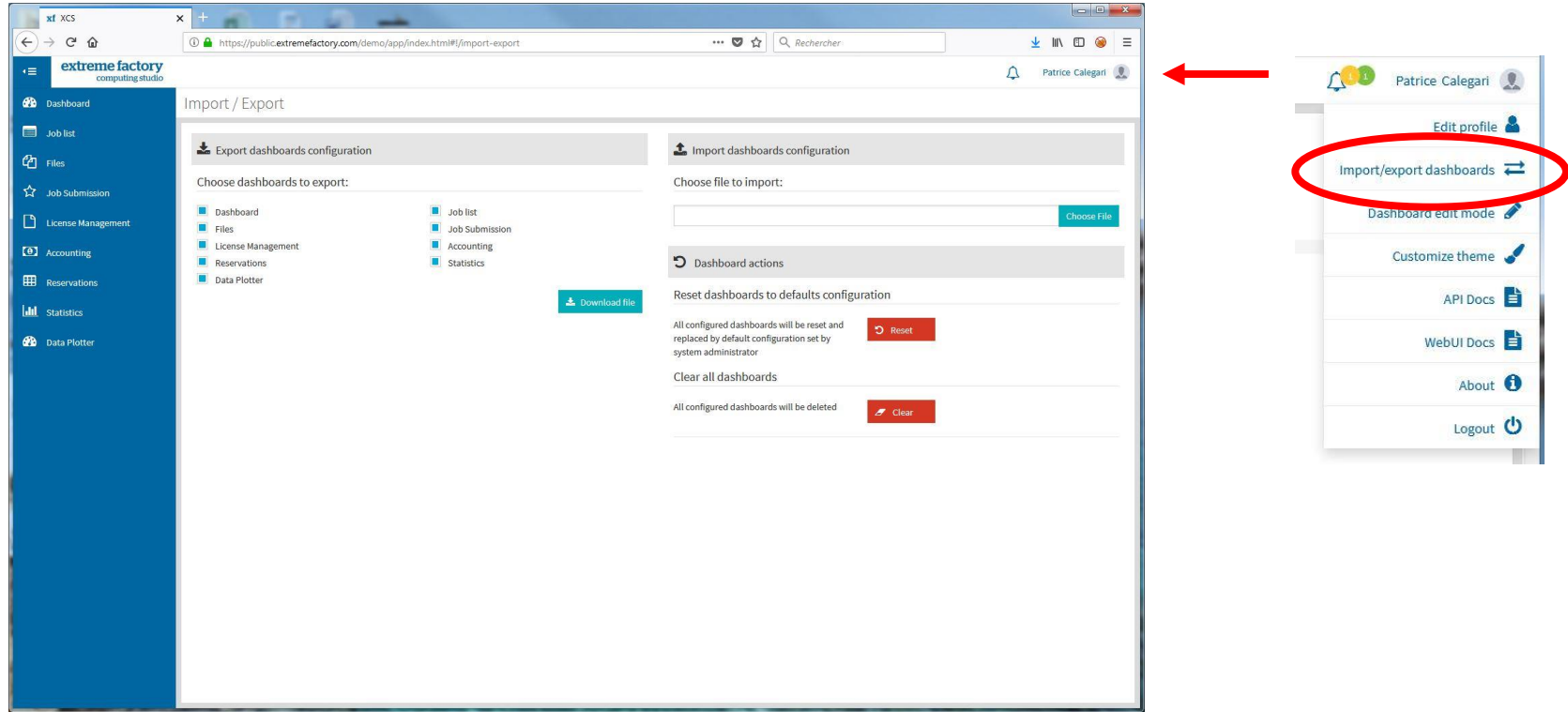
Example 3: 6 components with edited theme

The screenshot displays the XCS user dashboard interface, which is divided into several sections:

- Left Sidebar:** Contains navigation links for Files, Jobs, Accounting, Reservations, Job list, Submit Job, Statistics, License Management, and Dashboard (highlighted).
- Applications Section:** Shows a list of applications (ANSYS Fluent, ANSYS Workbench, AVBP, CST STUDIO SUITE, DeepLines Solver, Ensight, FINE Marine, GROMACS, LS-DYNA, OpenFOAM, Paraview, STAR-CCM+ GUI (POD), VASP, VMD, VPS (PAM-CRASH), Visit) and a configuration form for STAR-CCM+ (POD). The form includes fields for Project*, Cluster*, Name, Version*, Number of cores*, Queue*, Input File, Use advanced option, Native arguments, Compress result file, and a Submit form button.
- Job List Section:** Displays a table of jobs with columns: ID, Name, Application, Status, Status..., Created, Updated, Start date, and Work. The table lists various jobs with their respective statuses (Pending, Active, Terminating, Done, Job end...).
- File Explorer Section:** Shows a directory tree for /home/pmartin/Upload and a list of files with columns: Name, Size, Date, and Permissions. Files include DeepLinesData, EnsightData, Iemans17-amg6.04, Opti, Pamcrash, sae_step4, and StarviewData.
- Disk Usage Section:** A pie chart showing Total space (1.20 TB), Used space (0.85 TB), and Free space (0.35 TB).
- Job Status Section:** A bar chart showing the count of jobs in different states: Done (134), Failed (13), Terminating (21), Terminating (1), Pending (2), and Active (1).
- Links and Downloads Section:** Lists links for Quick User Guide (pdf file), XRV client (exe for Windows), XRV client (for Linux), and Atos home page.

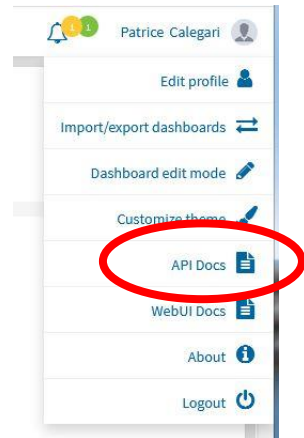
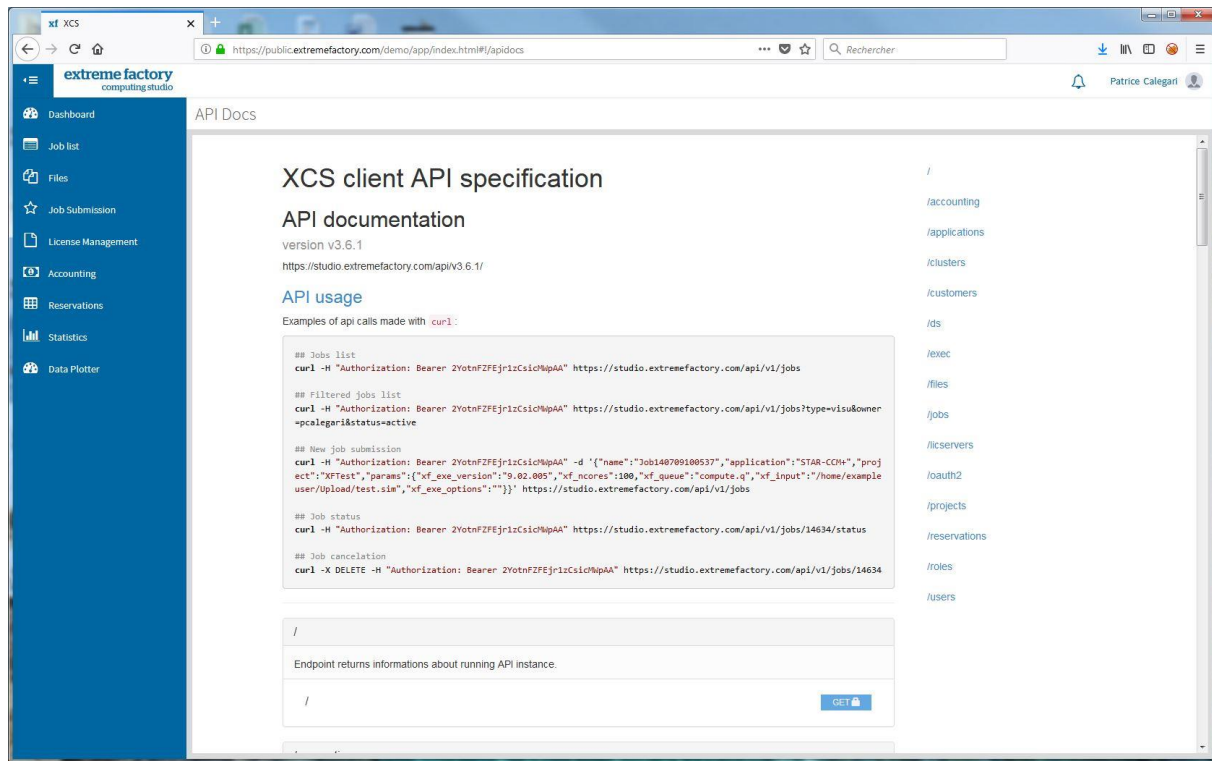
XCS dashboard main menu

import/export dashboards



XCS dashboard main menu

REST API documentation



XCS Fundamental concepts

Key software product for HPCaaS solutions

Give users and admins access to resources through web services

- Use of a GUI in a web browser that relies on a REST API

Be compatible with « all possible » environments

- Software, frameworks, middleware

Never be intrusive

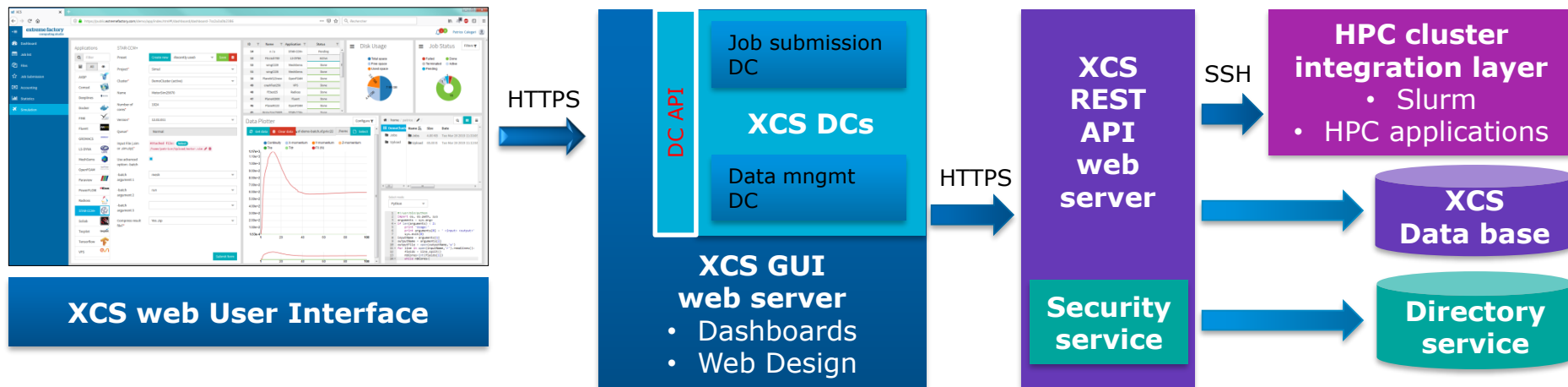
- The solution should be used in existing environments without modifying them

Keep all the intelligence in the REST API server

- The goal of the GUI is only to be the HMI (Human Machine Interface)

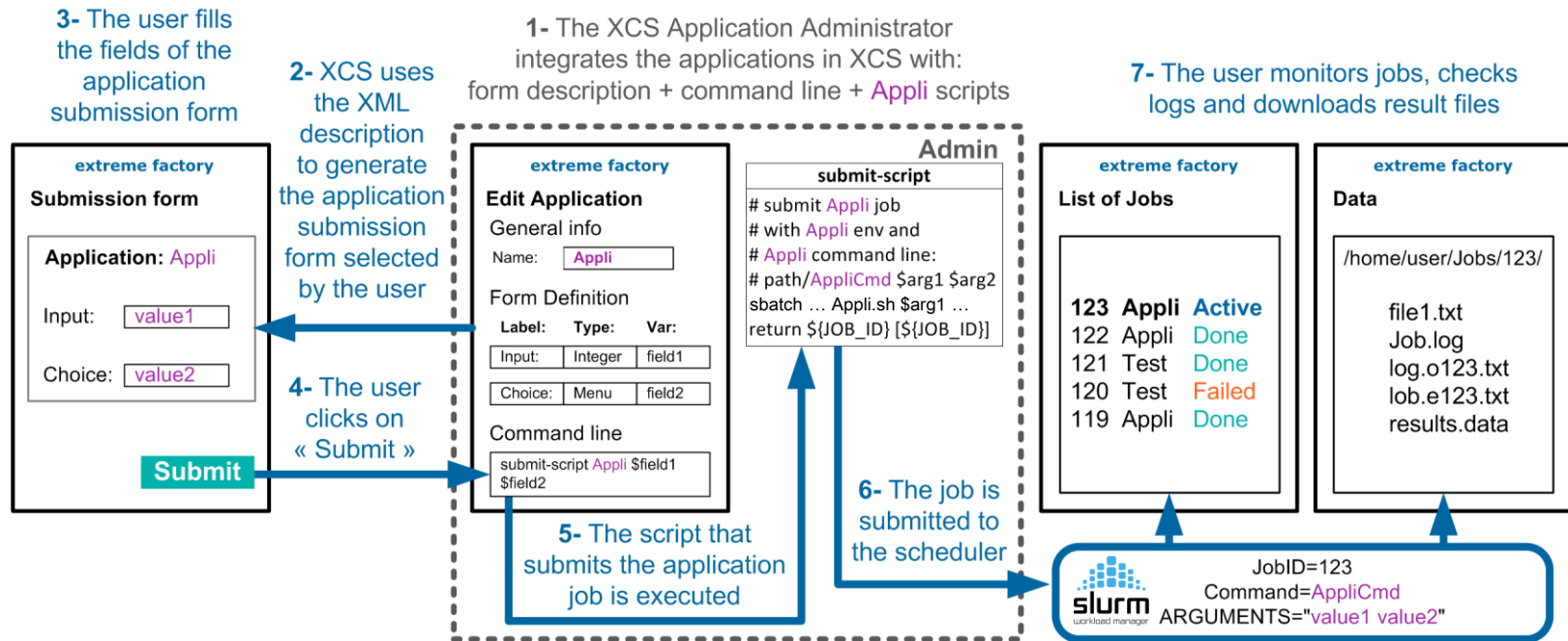
XCS architecture

current v3



DC = Dashboard Component

Slurm job submission workflow with XCS



XCS application administrator dashboard

HPC application general information

The screenshot displays the XCS application administrator dashboard. The left sidebar contains a navigation menu with the following items: Admin Tables, Clusters, Directory Services, Customers, Projects, Users, Applications (highlighted), Application list, Licenses, Roles, Accounting, Credit Formula, Credits, Dashboard Presets, and Statistics. The main content area is titled 'Application Administration' and is divided into two sections. The left section, 'Applications list', contains a table with the following data:

Application	Type	Id
Fluent	Computation	5
Gxgears	Visualization	2
OpenFOAM	Computation	8
Paraview	Visualization	3
STAR-CCM+	Computation	6
TensorFlow	Computation	9
Tensorflow DL	Computation	4
Test MPI	Computation	1

The right section, 'Edit application: Fluent', contains a form with two tabs: 'General information' and 'Forms definition'. The 'General information' tab is active and contains the following fields:

- Name: Fluent
- Description: Fluid Dynamics application from ANSYS
- Type: Computation
- Supported file extensions: sim, x
- Maximum wall time: 1000:00:00
- Job name: defined by user
- Choose the way of job name creation: defined by user
- Check job name uniqueness: ☐
- Software name: FluentDemo
- Command: xl_run -s \${application} -v \${version} -i \${input} -q \${queue} -n \${ncores} -j \${jobName} -- \${precision}
- Availability: ☐

At the bottom right of the form are three buttons: Delete, Save as copy, and Save.

XCS application administrator dashboard

HPC application form definition

The screenshot displays the XCS application administrator dashboard. The left sidebar contains a navigation menu with the following items: Admin Tables, Clusters, Directory Services, Customers, Projects, Users, Applications (selected), Application list, Licenses, Roles, Accounting, Credit Formula, Credits, Dashboard Presets, and Statistics. The main content area is titled 'Application Administration' and features an 'Applications list' table with columns for application name, type, and ID. The 'Fluent' application is selected, and its details are shown in the 'Edit application: Fluent' section. The 'Forms definition' tab is active, displaying a list of form components (checkbox, radio, options, options_ds, file, directory, file_and_directory, integer, decimal, number, area, text, text_without_space, comment) and a 'Form pages' section. The 'Form pages' section shows the 'STAR-CCM+' form page with fields for Version, Number of cores, Queue, Input File (.jou), and Precision. The bottom right corner of the dashboard includes buttons for Delete, Save as copy, and Save.

Application	Type	ID
Fluent	Computation	id: 5
Glgears	Visualization	id: 2
OpenFOAM	Computation	id: 8
Paraview	Visualization	id: 3
STAR-CCM+	Computation	id: 6
TensorFlow	Computation	id: 9
Tensorflow DL	Computation	id: 4
Test MPI	Computation	id: 1

Form components:

- checkbox
- radio
- options
- options_ds
- file
- directory
- file_and_directory
- integer
- decimal
- number
- area
- text
- text_without_space
- comment

Form pages:

- STAR-CCM+
- Version *
- Number of cores *
- Queue *
- Input File (.jou) * Attached file: Select
- Precision

3

BEM

Bull Efficiency Manager

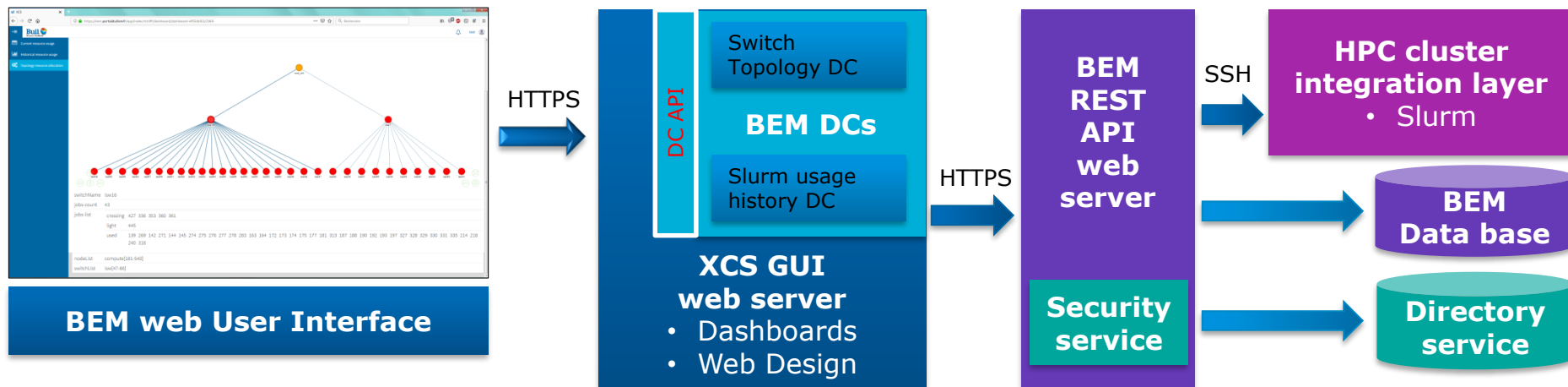
Bull Efficiency Manager (BEM)

Introduction

- ▶ **Slurm** has been enhanced by Bull/Atos to provide additional functionality including topology-aware resource allocation and advanced placement policies,
- ▶ **Bull Efficiency Manager (BEM)** is the web application running upon the **Slurm** workload manager to show cluster details interactively,
- ▶ **BEM** dashboards show information in graphs and tables for both current and previous archived data about cluster resources.

XCS architecture

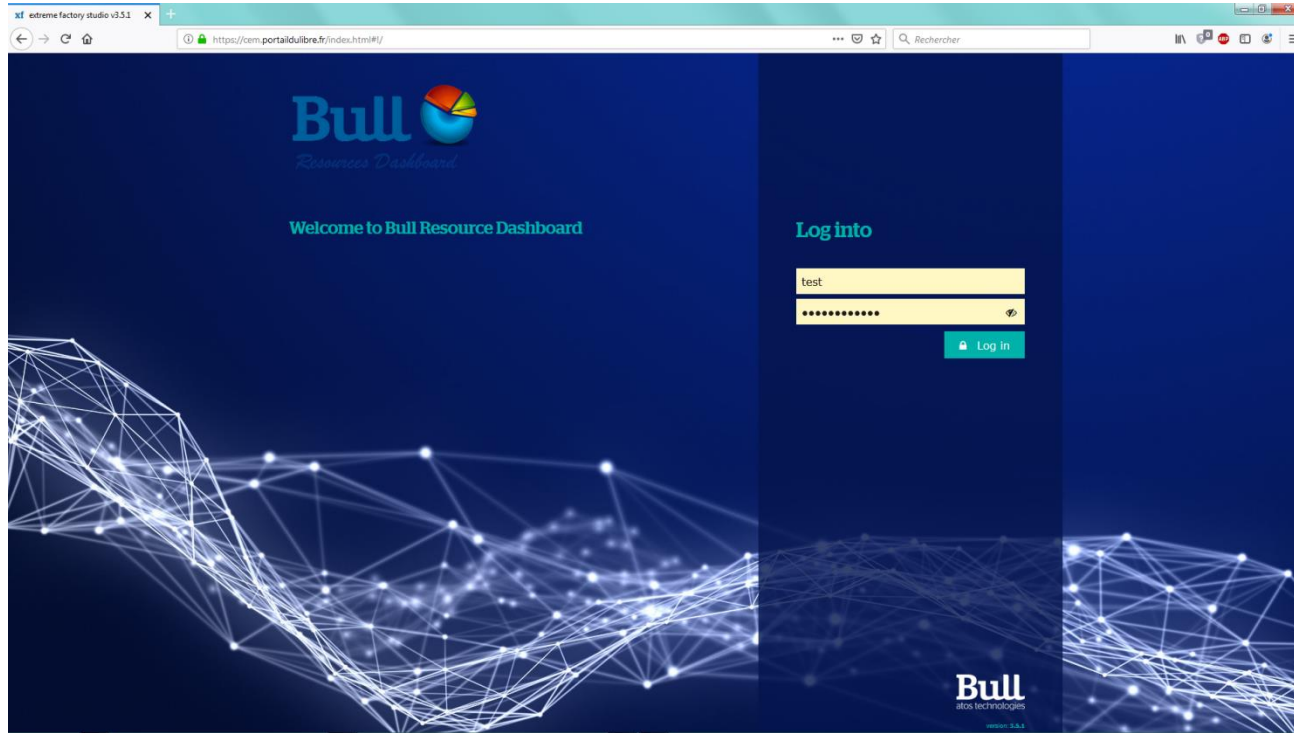
current v3



DC = Dashboard Component

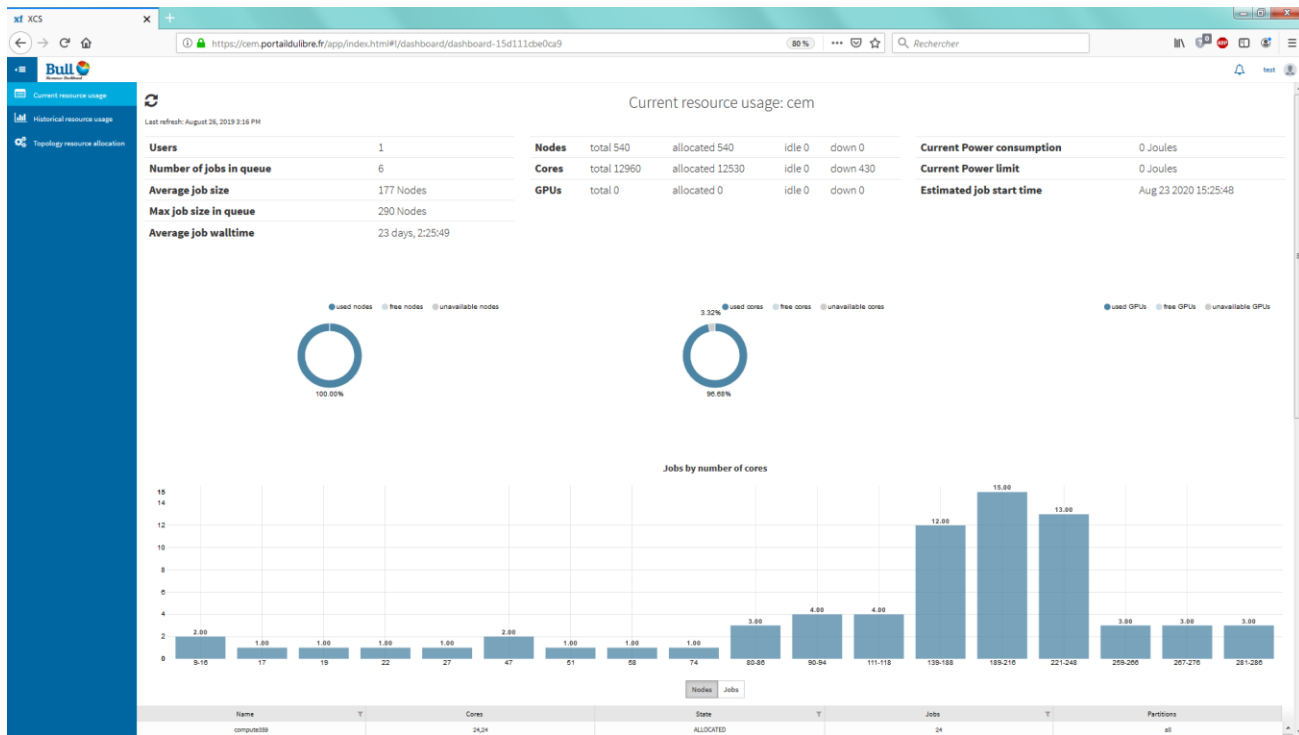
BEM

Login Page



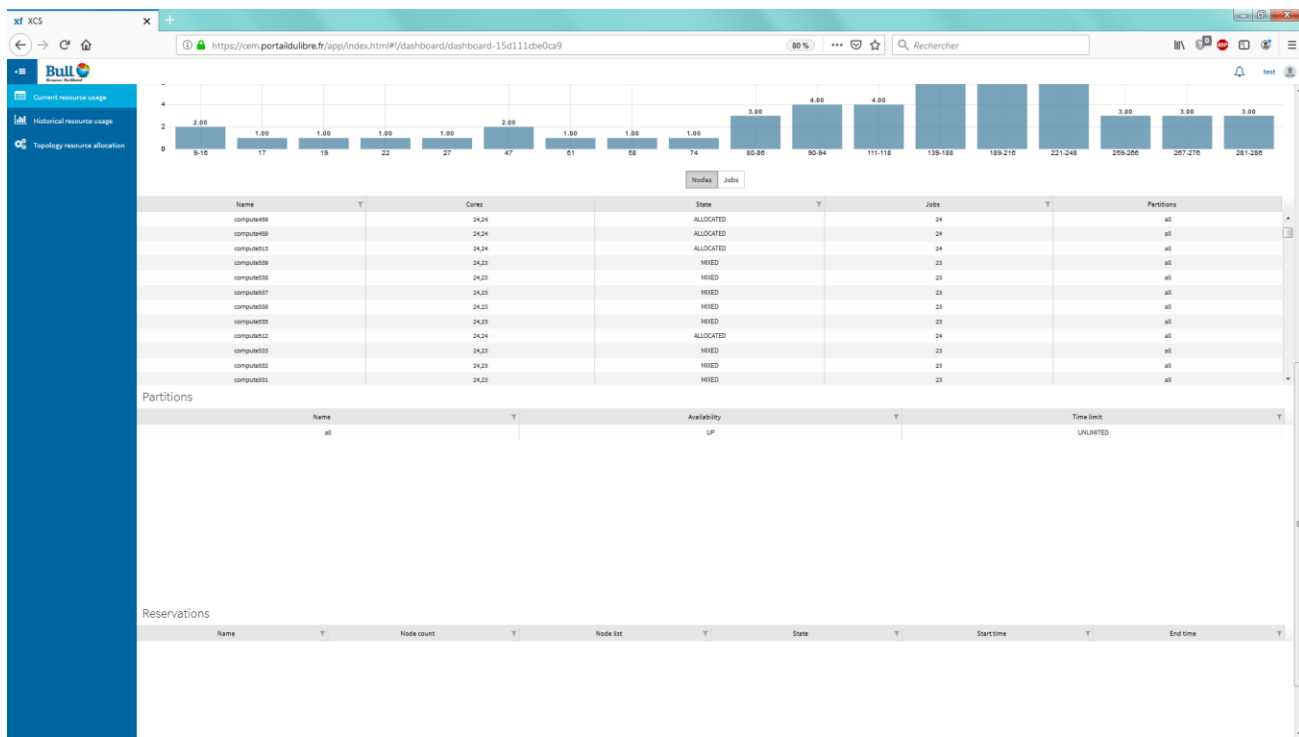
BEM

Current resource usage 1/3



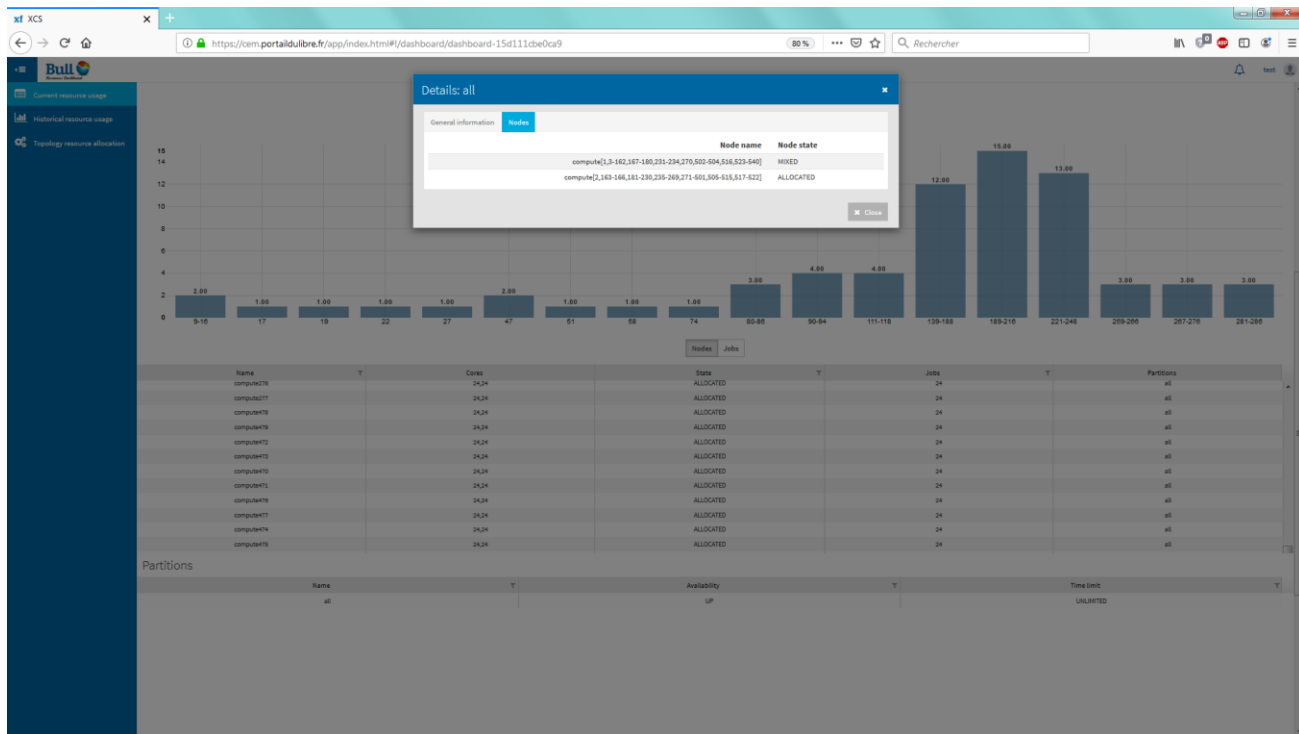
BEM

Current resource usage 2/3



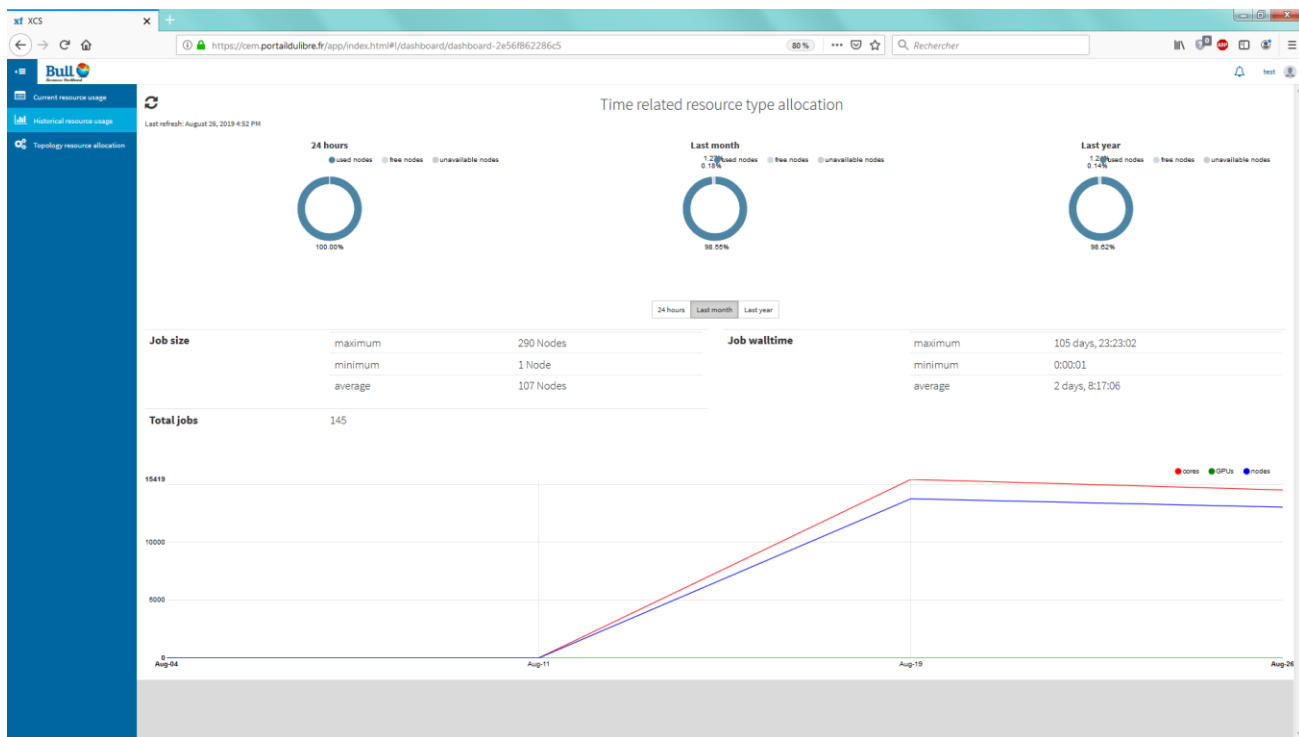
BEM

Current resource usage 3/3



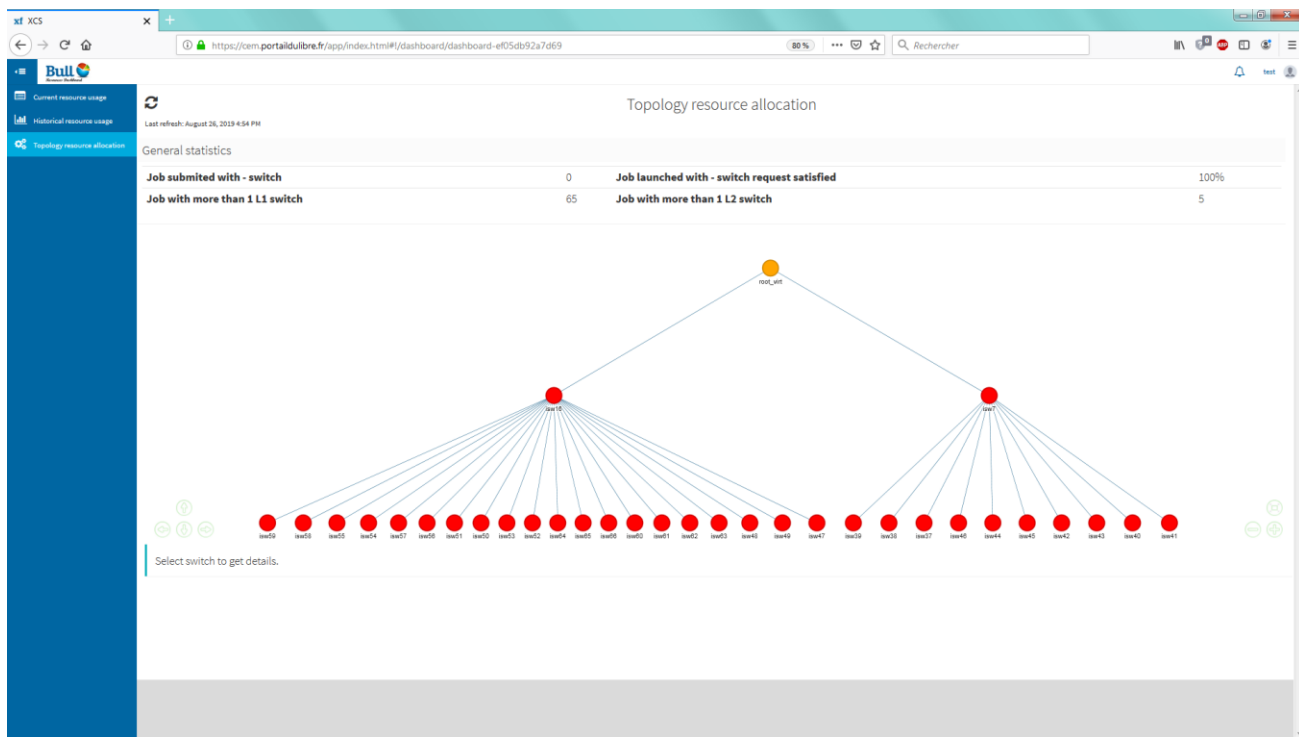
BEM

Historical resource usage



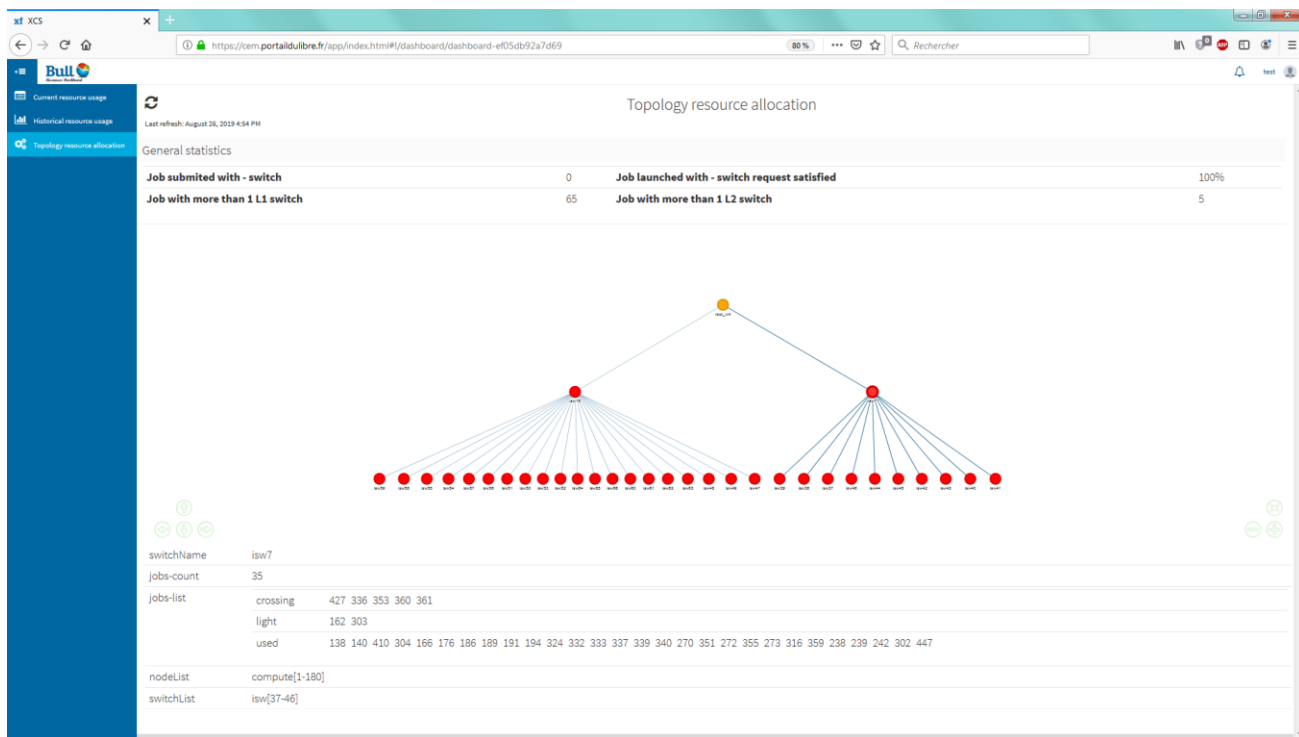
BEM

Topology resource allocation 1/3



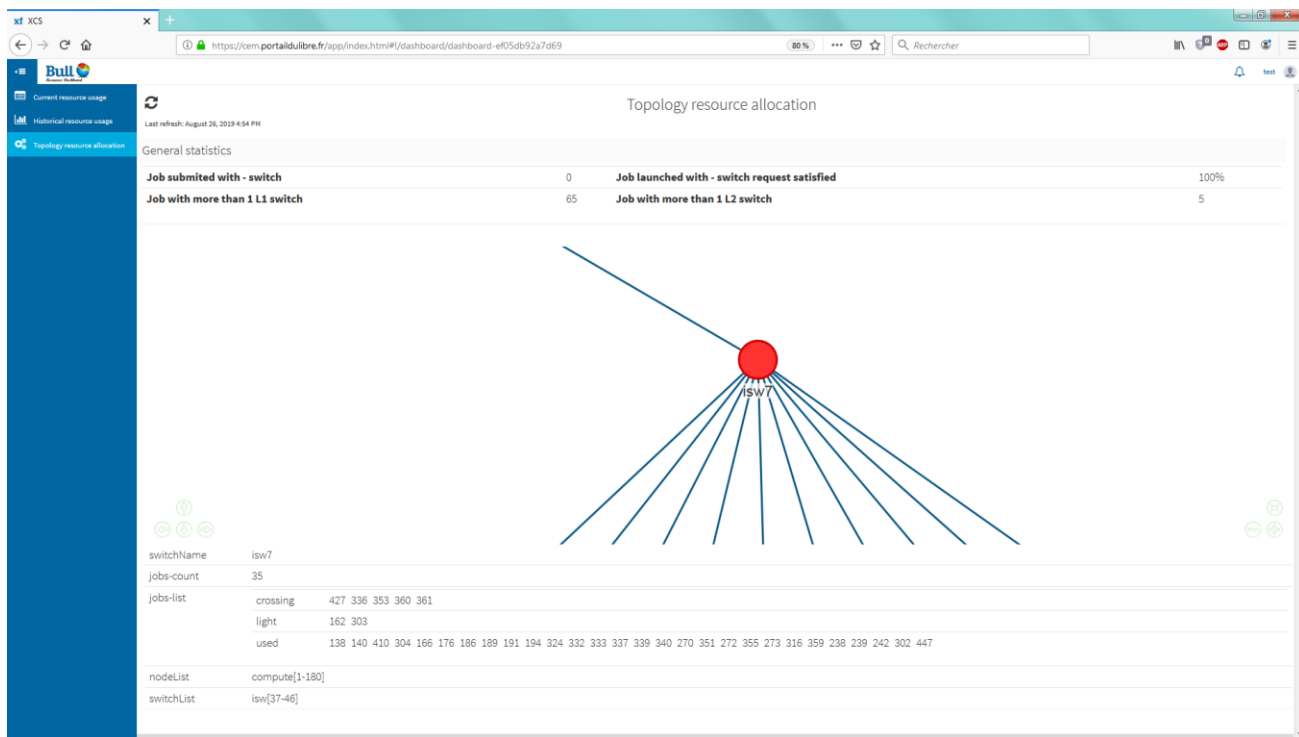
BEM

Current resource usage 2/3



BEM

Current resource usage 3/3



4

Conclusion & Future Work

Conclusions

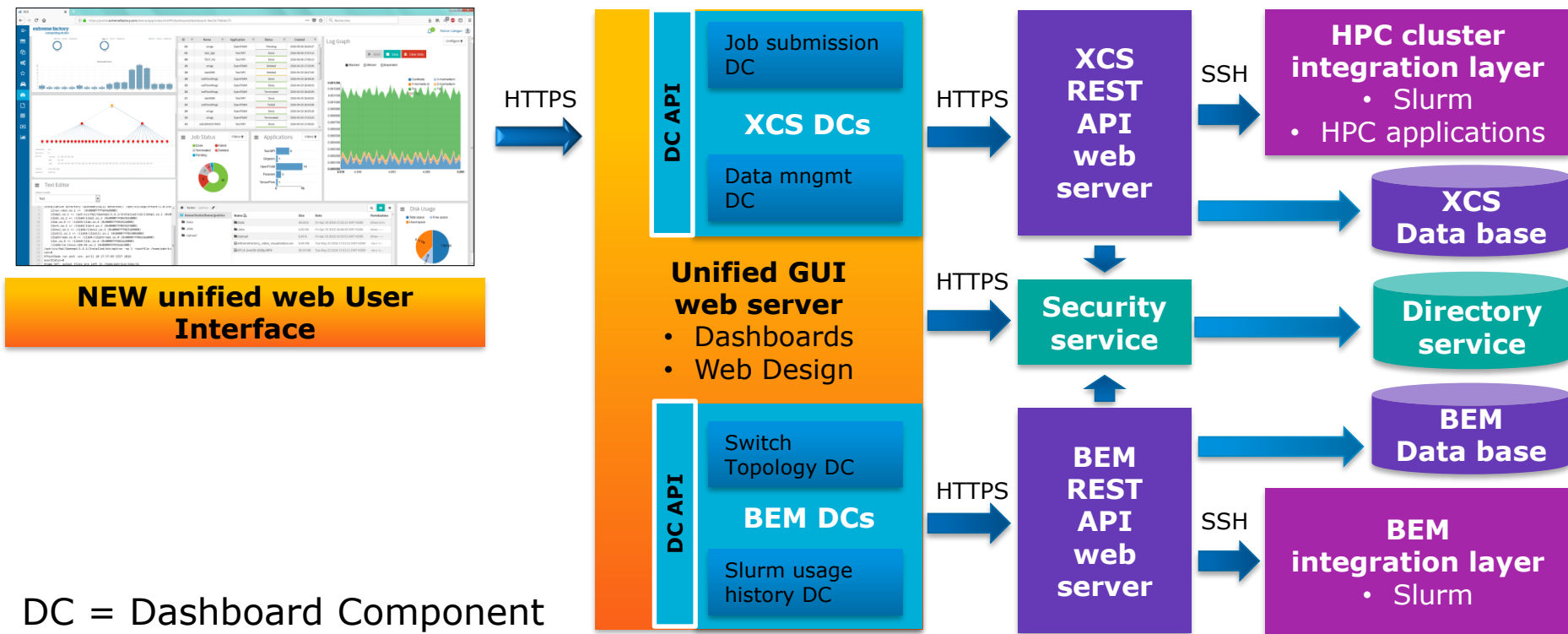
- ▶ XCS is successfully used in production on many sites for several years and it evolves continuously
- ▶ BEM is still under development and the first Minimal Viable Product (MVP) is very promising
- ▶ Mobile devices are becoming a new standard way for doing “everything”, so such a web portal approach will soon be mandatory for new users (unexperienced users, young scientist of the new generation, non-technical managers, etc.)

On going and future work

- ▶ Unify both interfaces (XCS & BEM) and share a unique security service
- ▶ Add new features to administrate Slurm
- ▶ We develop a new web portal framework to federate all our HPC, AI & Quantum tools/microservices. It is an evolution of our current XCS solution with:
 - a generic web GUI framework
 - a security service (with flexible identity, authentication with SSO and authorization management).
 - global services (reverse proxy, gateway, discovery service, etc.)

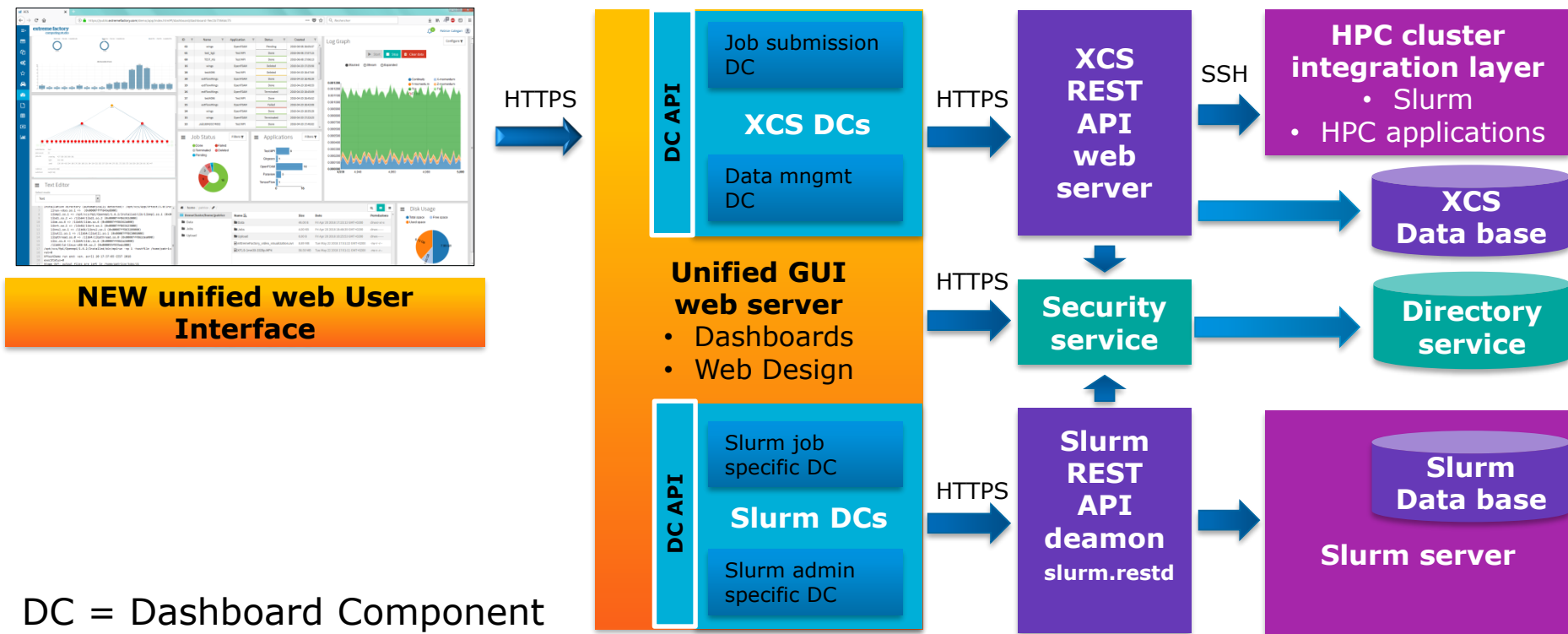
XCS and BEM architecture

Complete solution to be developed in 2020



XCS and Slurm native REST service architecture

Possible evolution...



Thank you

For more information please contact:

Mathis Clayer for Slurm topics (mathis.clayer@atos.net)

Patrice Calegari for GUI topics (patrice.calegari@atos.net)

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The Atos logo, featuring the word "Atos" in a white, bold, sans-serif font. The letter 'o' is stylized with a circular cutout in the center. The logo is positioned in the bottom right corner of the slide.

More on HPC web portals

- ▶ **Web Portals for High-performance Computing: A Survey**

- 36 page journal paper published by ACM
- <https://dl.acm.org/citation.cfm?id=3197385>

- ▶ **Democratization of HPC through the Use of Web Portals: Different Strategies**

- Panel at SC'19 in Denver, November 20th, 3:30pm-5pm
- <https://sc19.supercomputing.org/presentation/?id=pan102&sess=sess223>