A fully configurable HPC web portal for managing Slurm jobs

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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
Context of the projects
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
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
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
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

1. The XCS Application Administrator integrates the applications in XCS with:
   - form description
   - command line
   - Appli scripts

2. XCS uses the XML description to generate the application submission form selected by the user.

3. The user fills the fields of the application submission form.

4. The user clicks on "Submit".

5. The script that submits the application job is executed.

6. The job is submitted to the scheduler.

7. The user monitors jobs, checks logs and downloads result files.

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Application: Appli
Input: value1
Choice: value2

Command line:
submit-script Appli $field1 $field2

Example script:

```bash
#!/bin/bash

# submit Appli job
# with Appli env and
# Appli command line:
# path/AppliCmd $arg1 $arg2

sbatch ...
Appli.sh $arg1 ...
return ${JOB_ID} [${JOB_ID}]
```

List of Jobs:

- **123 Appli** Active
- **122 Appli** Done
- **121 Test** Done
- **120 Test** Failed
- **119 Appli** Done

Data:

- /home/user/Jobs/123/
  - file1.txt
  - Job.log
  - log.o123.txt
  - lob.e123.txt
  - results.data

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JobID=123
Command=AplliCmd
ARGUMENTS="value1 value2"
XCS application administrator dashboard

HPC application general information
XCS application administrator dashboard

HPC application form definition
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

Current resource usage 1/3
BEM

Current resource usage 2/3
BEM

Current resource usage 3/3
Historical resource usage
BEM

Topology resource allocation 1/3
BEM

Current resource usage 2/3
BEM
Current resource usage 3/3
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

**NEW unified web User Interface**

**DC = Dashboard Component**

**XCS and BEM architecture**

**Unified web server**
- Dashboards
- Web Design

**XCS DCs**
- Job submission DC
- Data mgmt DC

**BEM DCs**
- Switch Topology DC
- Slurm usage history DC

**HPC cluster integration layer**
- Slurm
- HPC applications

**XCS Data base**

**BEM Data base**

**Security service**

**REST API web server**

**BEM REST API web server**

**Directory service**

**REST API**

**BEM integration layer**
- Slurm
**XCS and Slurm native REST service architecture**

*Possible evolution...*

NEW unified web User Interface

**Unified GUI**
- Dashboards
- Web Design

**DCs**
- Job submission DC
- Data mgmt DC
- Slurm job specific DC
- Slurm admin specific DC

**API**
- XCS
- Slurm

**Service**
- Security
- Directory

**Data base**
- XCS
- Slurm

**Integration layer**
- Slurm
- HPC applications

**NEW unified web User Interface**
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)
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](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 20\(^{th}\), 3:30pm-5pm
  - [https://sc19.supercomputing.org/presentation/?id=pan102&sess=sess223](https://sc19.supercomputing.org/presentation/?id=pan102&sess=sess223)