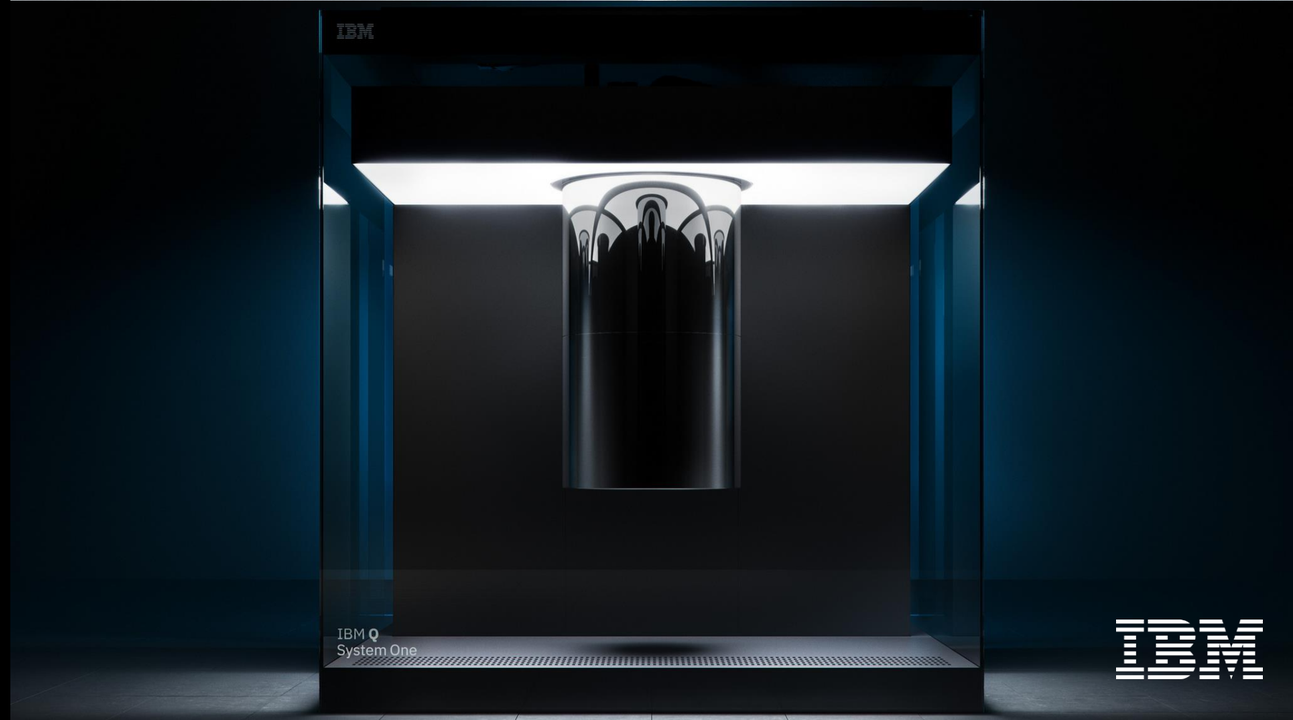
IBM at ISC19

IBM Spectrum LSF & Scale User Group

IBM Spectrum LSF Update

Bill.McMillan@uk.ibm.com

Global Offering Leader
IBM Spectrum LSF
IBM Cognitive Systems



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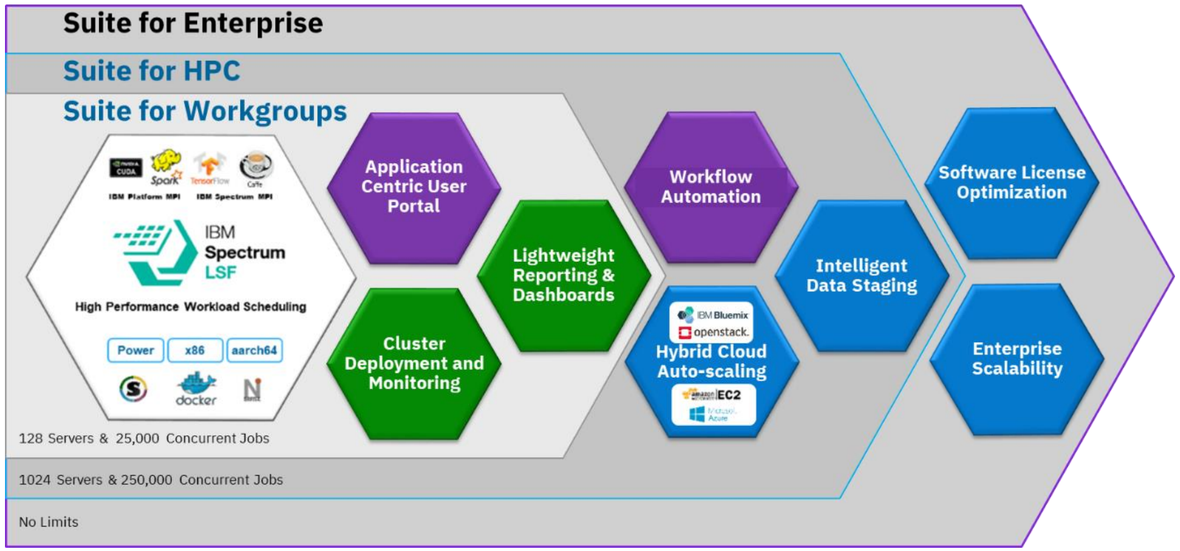
IBM Spectrum LSF Suite

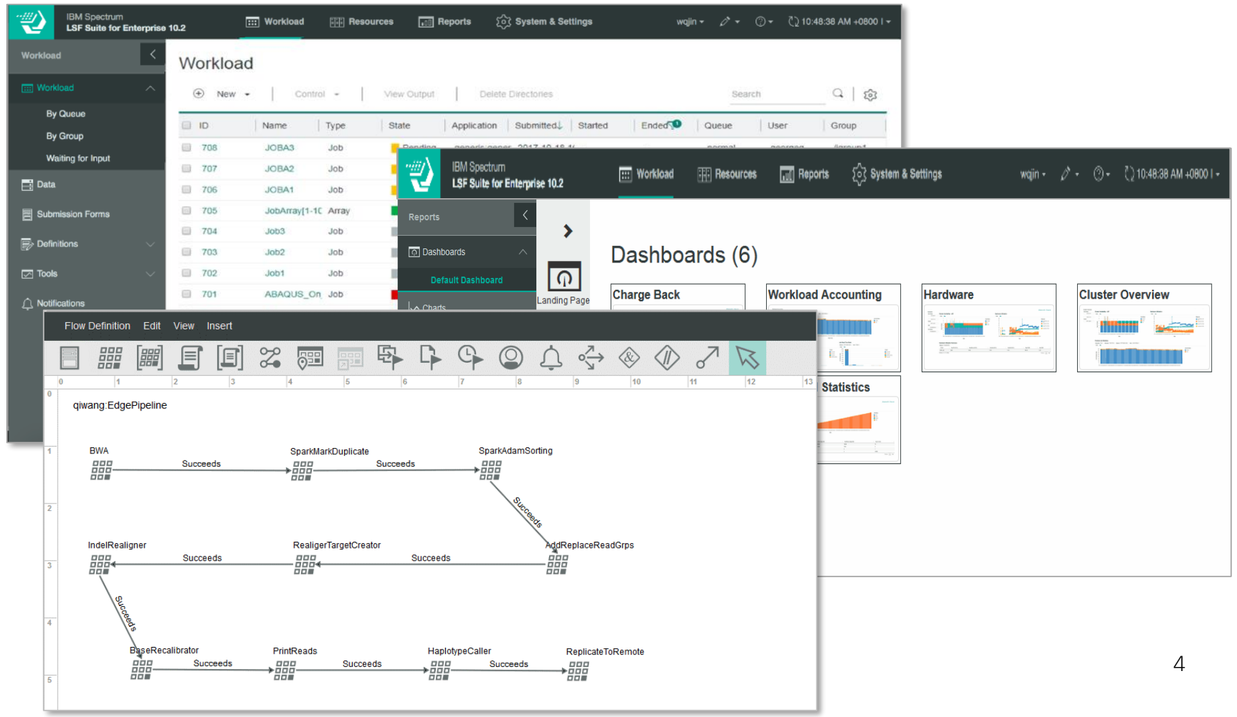
Everything you need for Workgroup, HPC or Enterprise scale.

- **Enhanced Utilization of assets through effective scheduling and sharing policies**
- **Enhancing User Productivity through ease of use, accessibility and simplification**
- **Operational Efficiency through insight of how the HPC environment is being used**

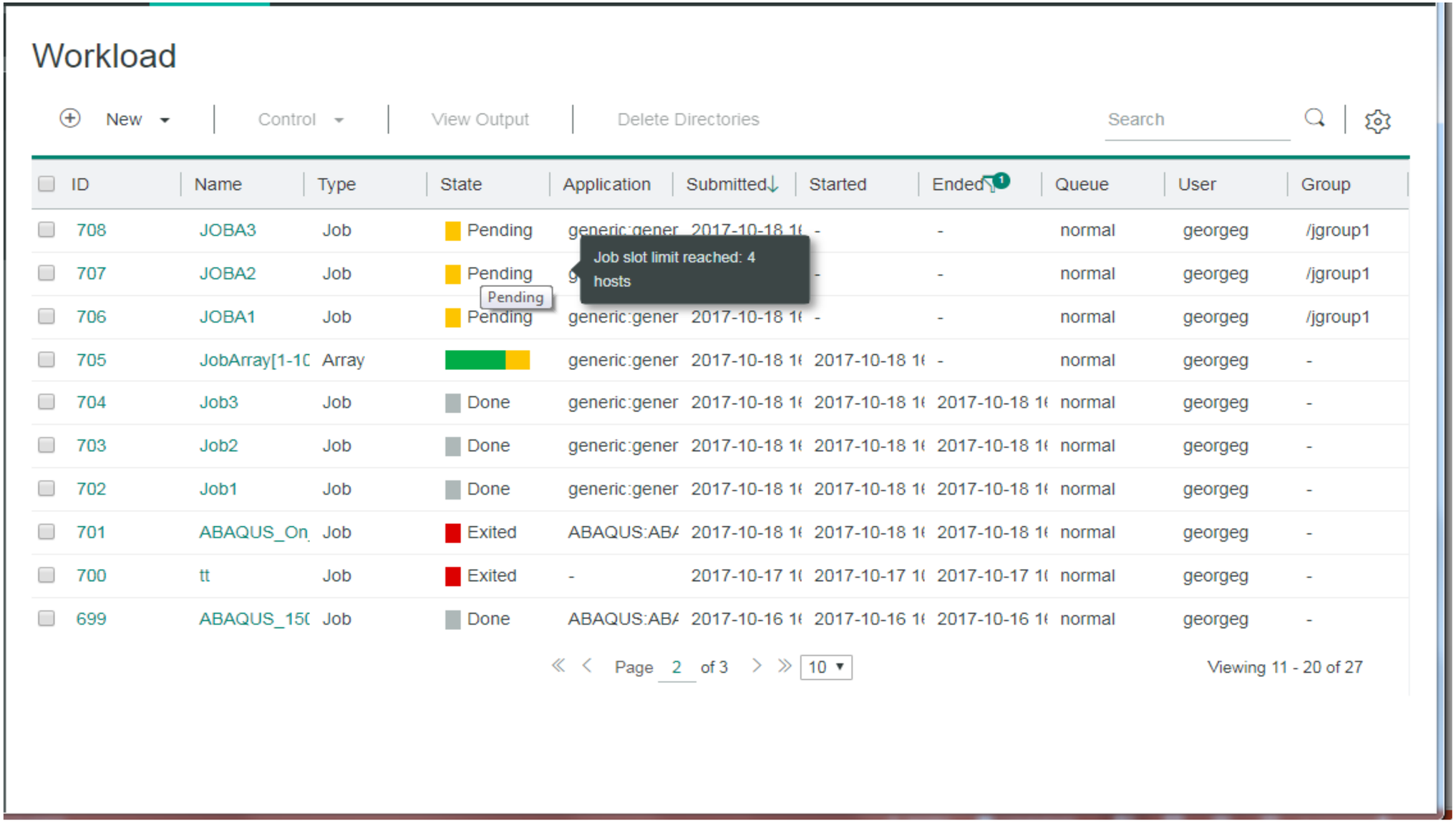
The LSF Suite for HPC is available at no charge via the IBM Academic Initiative

Hourly Pricing now available.





Simplify the User Experience



Guided Submission

The administrator or power user can define templates for specific applications.

– Display as a form or wizard (new in SPK8)

Templates:

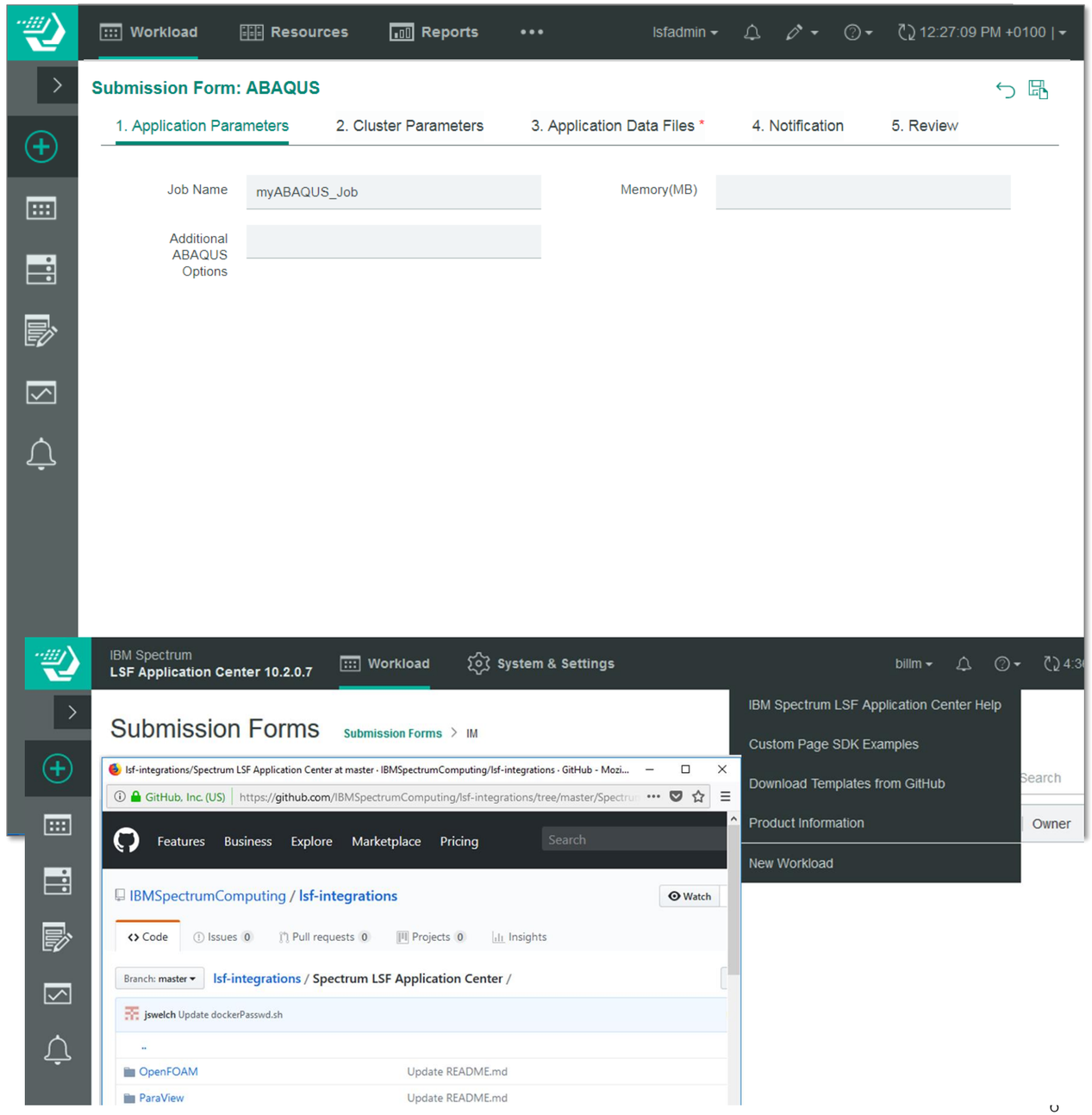
– Simplify the use of the application exposing specific fields with (optional) predefined options/values.

– Reduces user training requirements, errors and support user

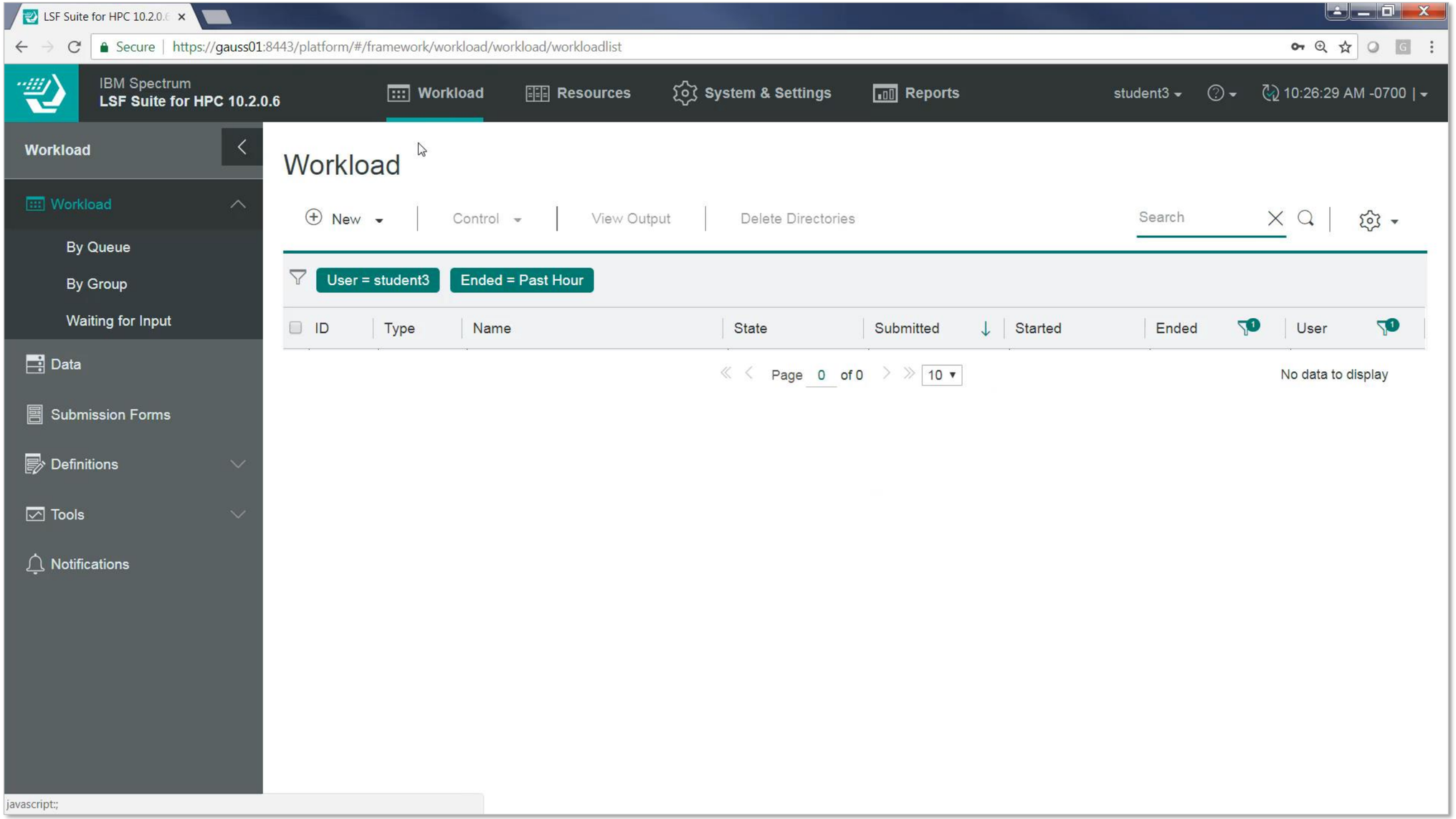
– Makes HPC more accessible – point and click submission

– Templates can handle dependencies and define how input/output files for an application should be viewed/graphed.

– Download additional/updated templates from Github

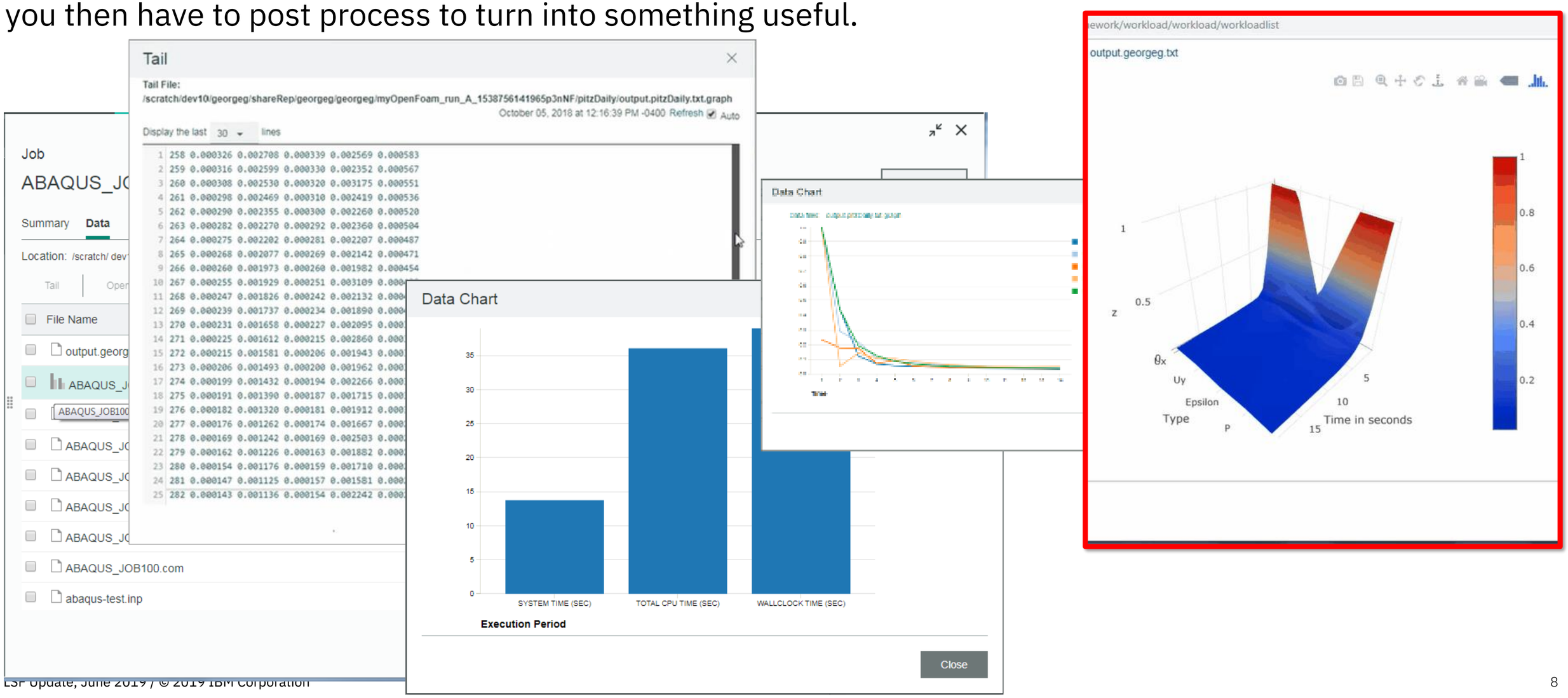


Example – Containerised Tensorflow + Tensorboard

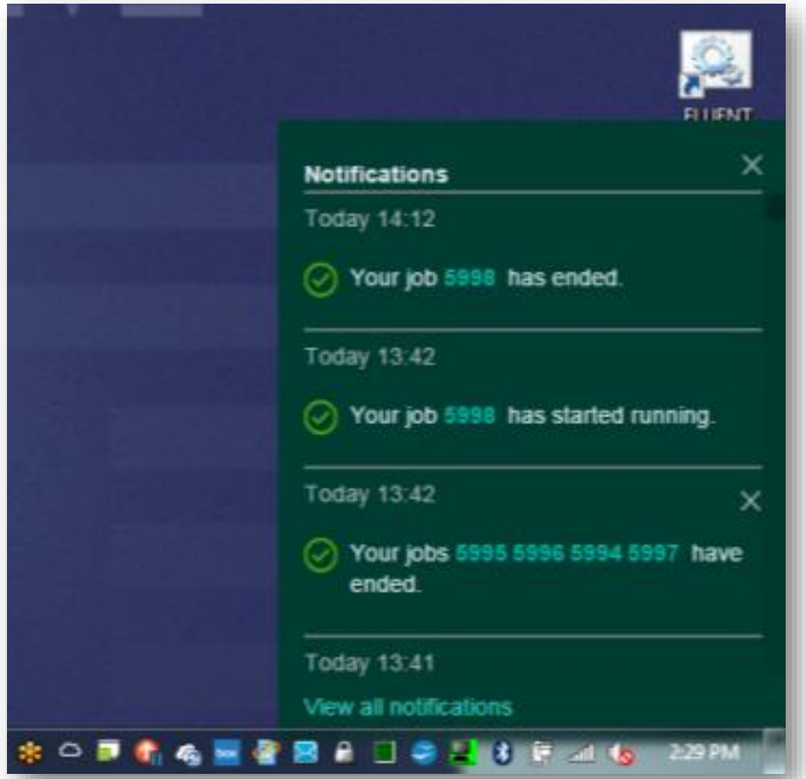


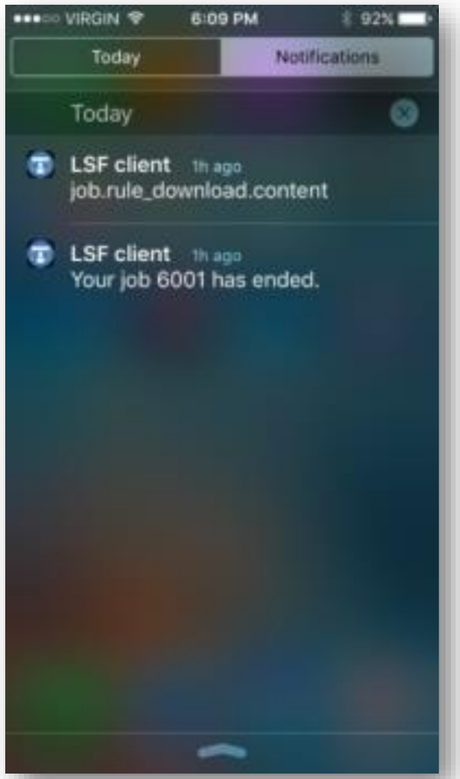
Simplifying Viewing of Results

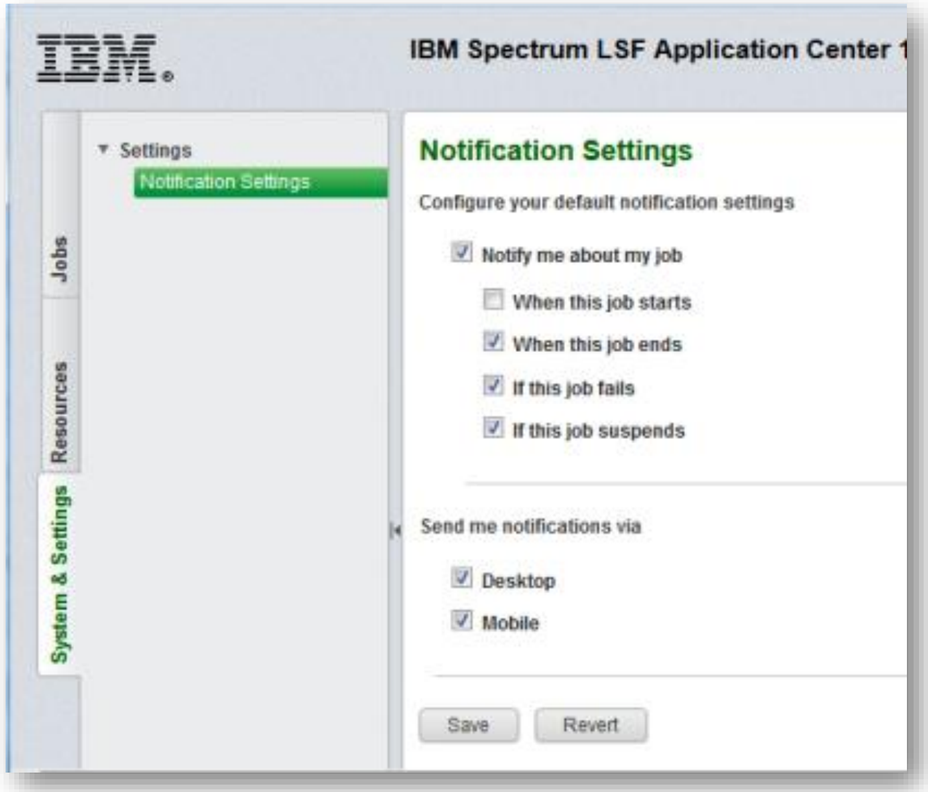
The output of most applications are one or more text files which you then have to post process to turn into something useful.



Inform the user of the progress, completion or failure of their work







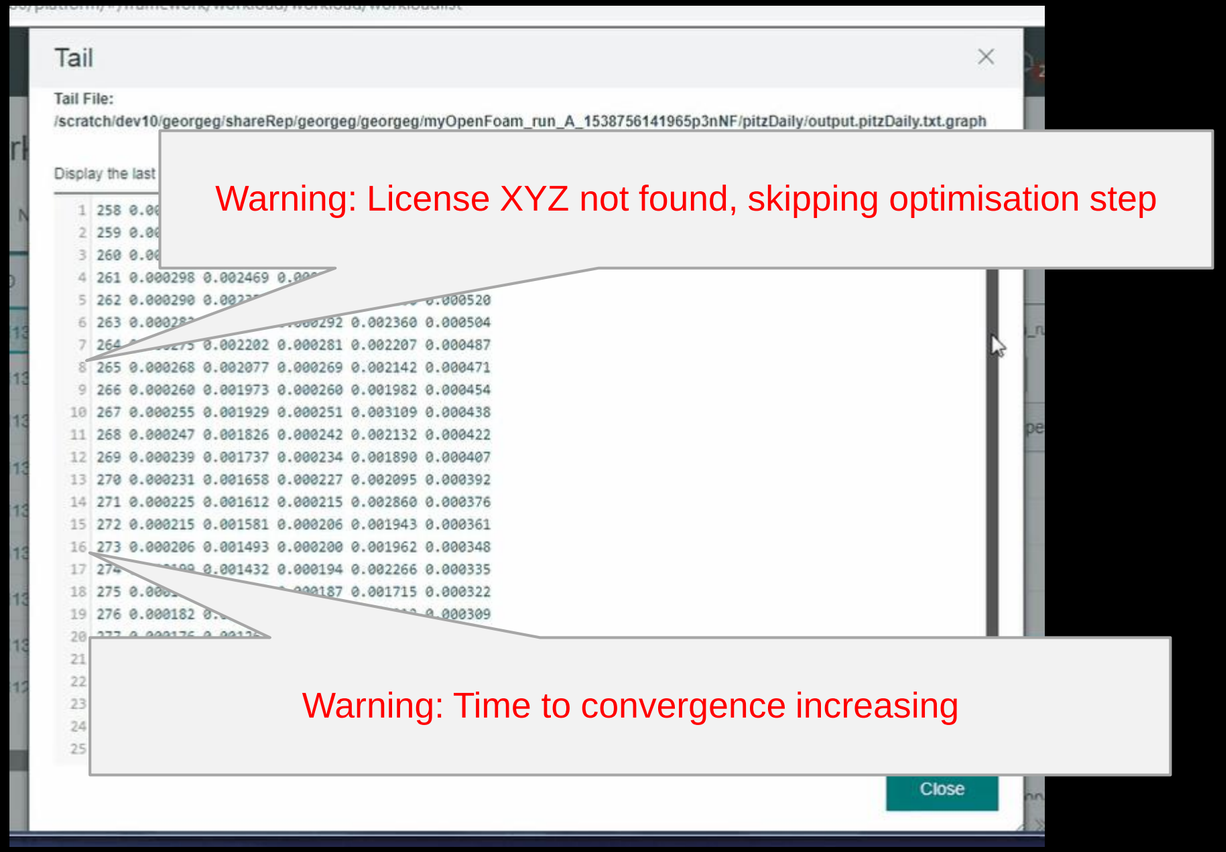
Email, desktop, browser or mobile

But what about jobs that are still running, but are not quite “right”?

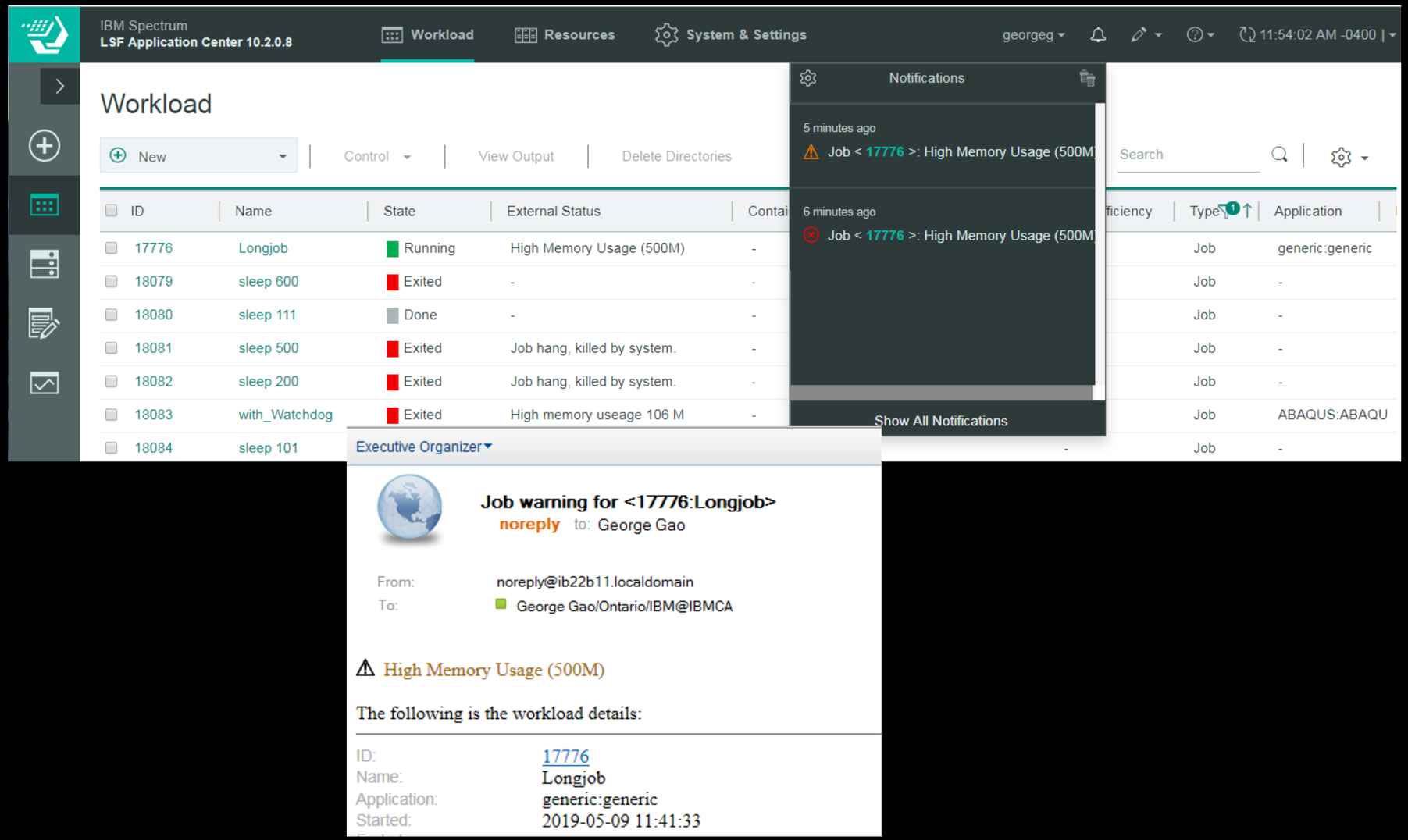
Users repeatedly check the output of applications to check that the application is doing the right thing.

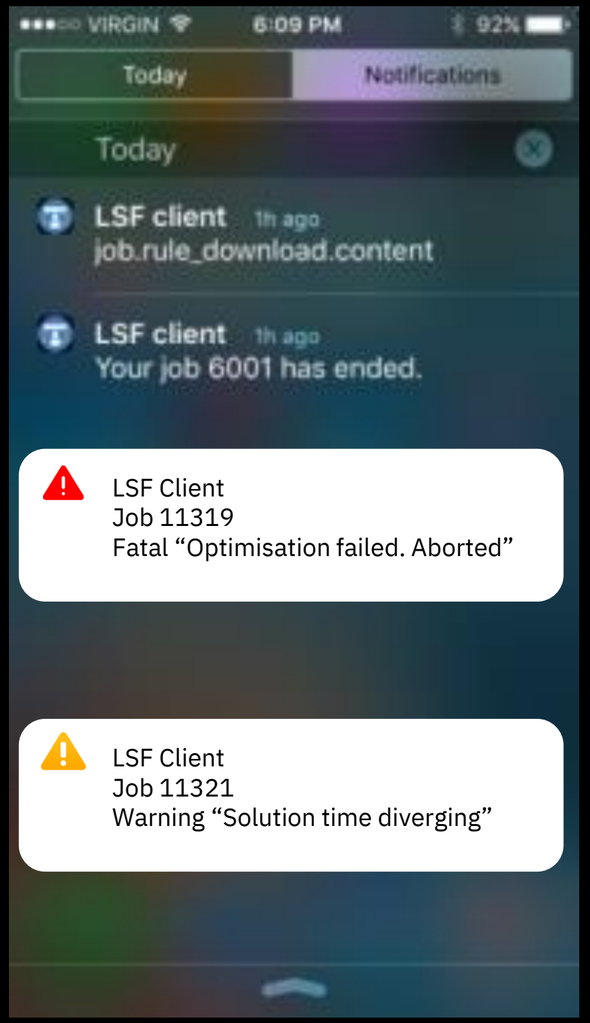
There may be something wrong, but it hasn’t caused the application to fail – such as a solution not converging.

If the user doesn’t notice this, the job may run for many hours and produce no useful output.



New Application Specific Watchdog





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Focus Areas 2019-2021

Core Scheduling

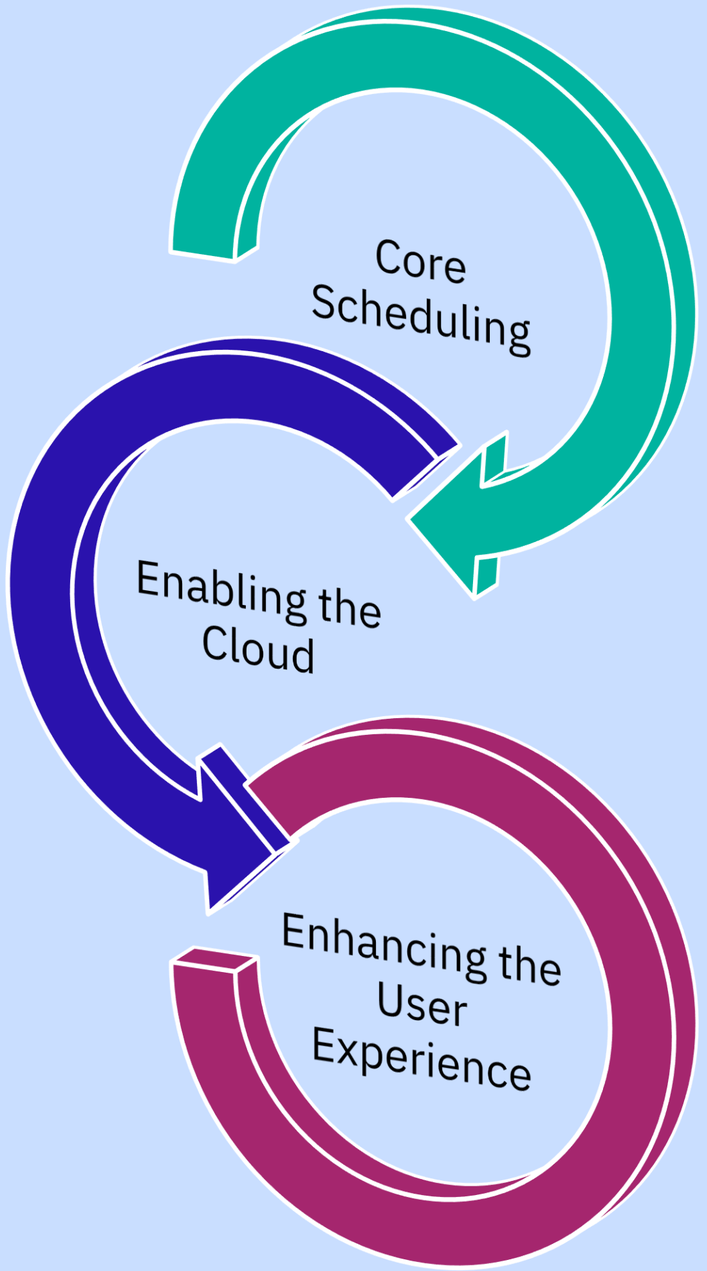
- **Performance & Scalability**
- **Workload Policies**
- **Technology: GPU's & Containers**

Enabling Multi-Cloud

- **When to forward work**
- **Ensuring the right data is available**
- **Intelligent autoscaling the Cloud**

Enhancing the User Experience

- **Simplifying HPC**
- **Computational Workflows**
- **Operational Visibility**



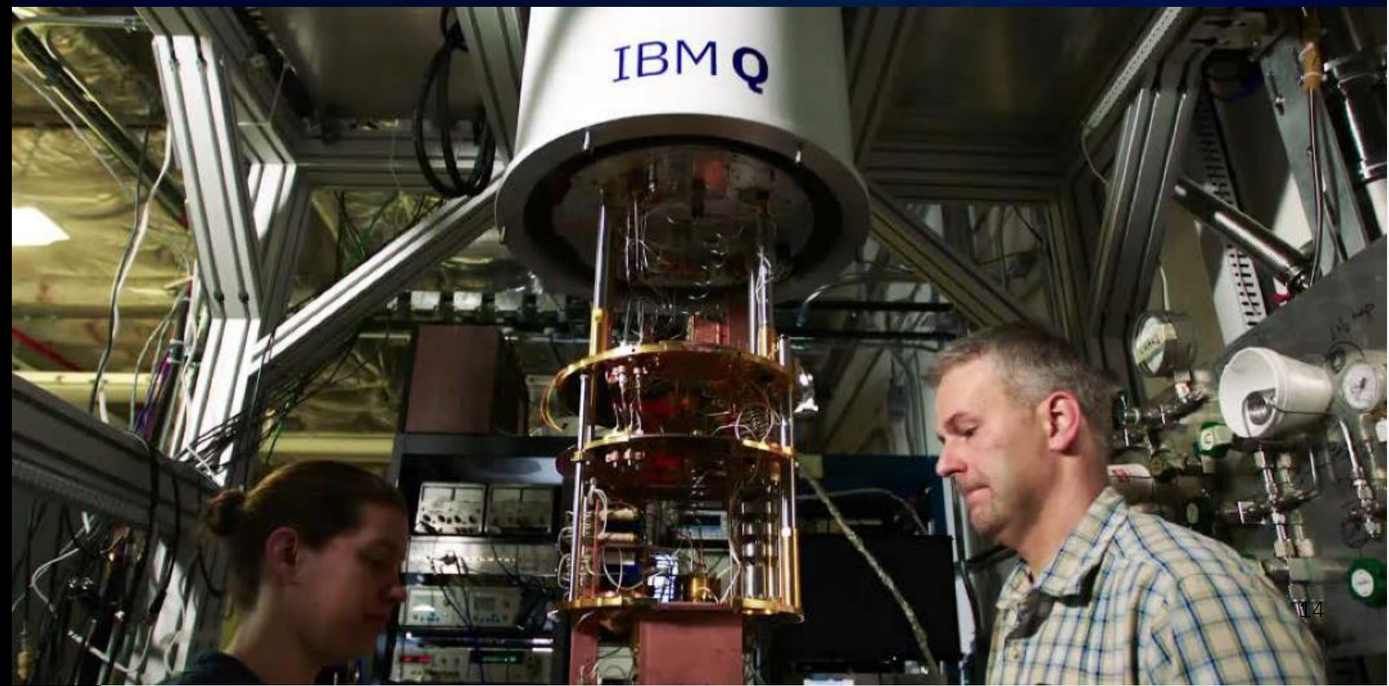
Cutting Edge Performance and Scalability

Continuous Performance Improvement:

- LSF 10 delivers ~3.8x improvement in scheduling performance.
- Every update contains new performance optimizations – 6 monthly updates.

Scalability:

- The largest single cluster today is in excess of 12,000 hosts running large scale parallel simulations.
- The largest high throughput cluster is around 6,500 hosts, running 7M+ jobs per day, and bursting 50,000+ cores to the cloud
- CORAL and IBM Q

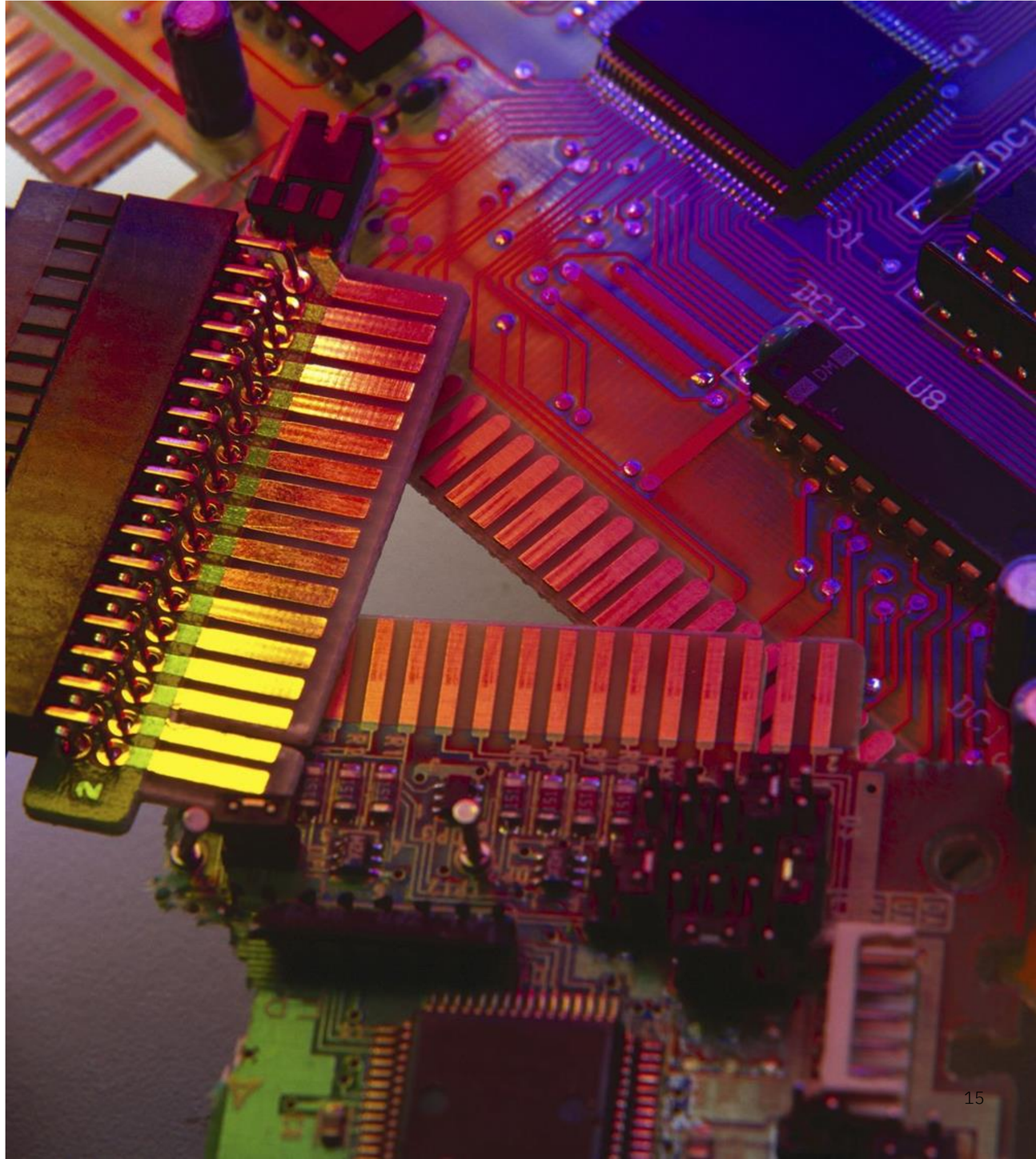


Market Leading GPU Support

Over 10 years of GPU functionality

Recent enhancements:

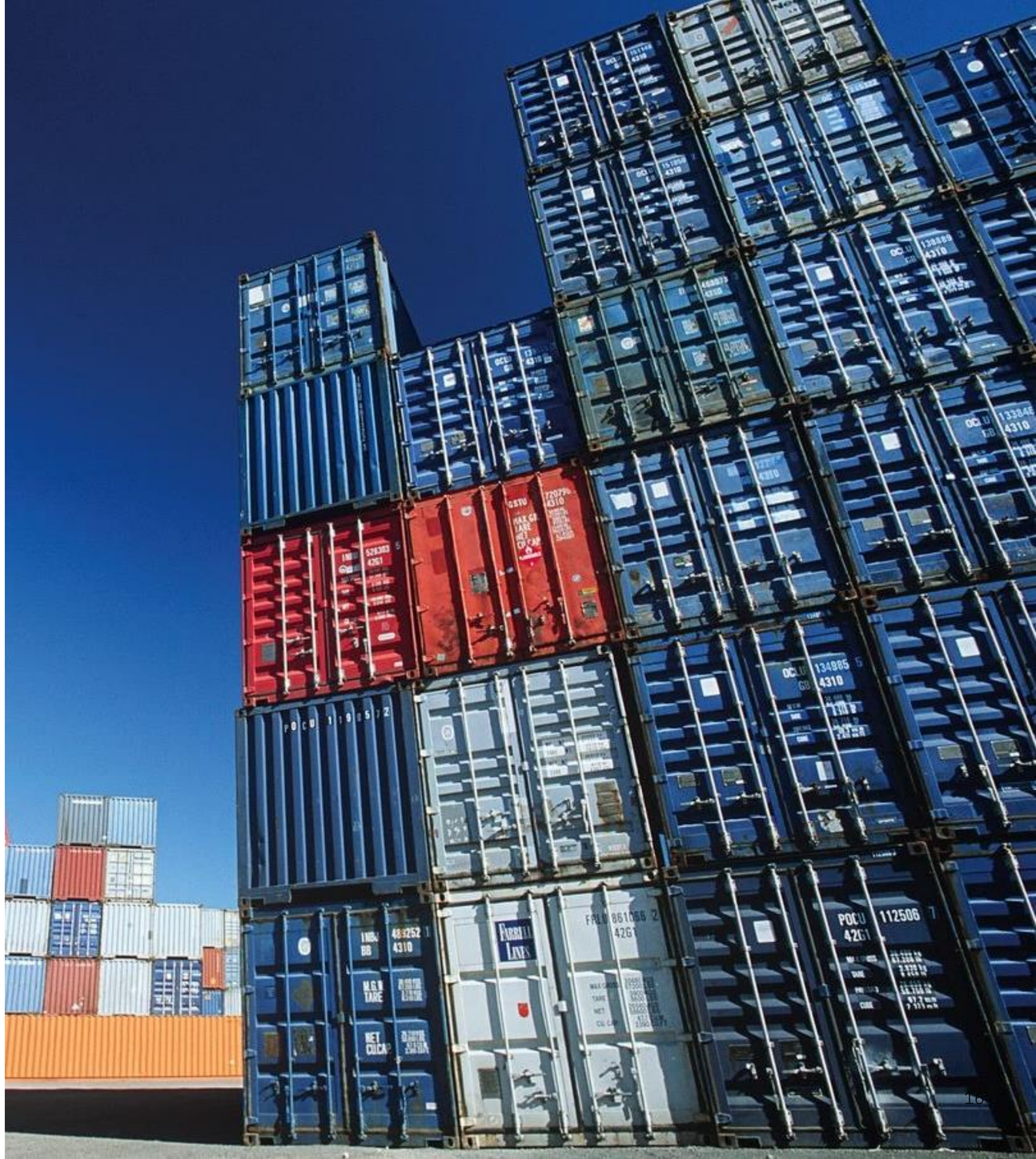
- “Zero Config” - LSF will now automatically detect and configure GPU support. This means that users can take advantage of GPU’s as soon as Spectrum LSF installed.
- Simplified (-gpu) syntax
- GPU Fairshare & GPU Pre-emption
- Multi-MPS Support – Multiple MPS daemons per job and/or multiple jobs per MPS daemon (spk8)
- Additional affinity options (spk8)



Running Containerized Workloads with LSF

LSF 10 provides:

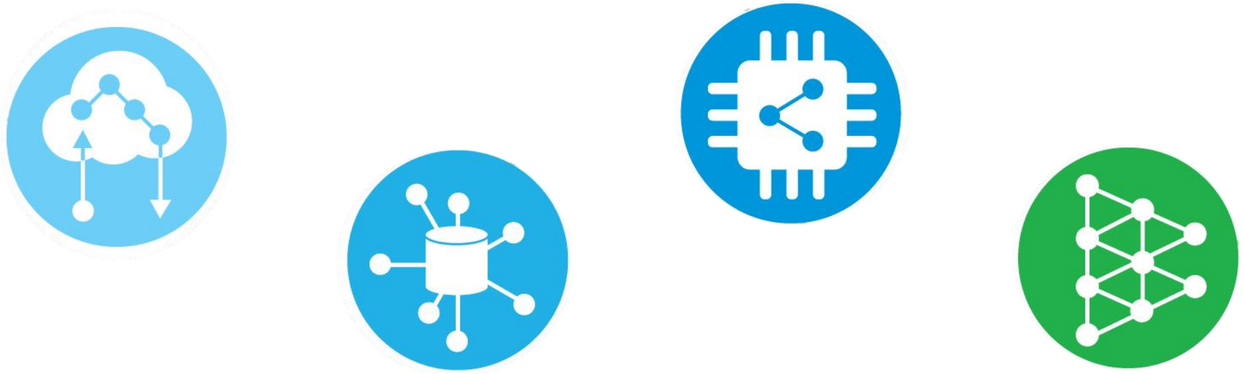
- Integrated support for running containerized applications with Docker, Shifter and Singularity.
- Transparent container access – users don’t need to learn complex container syntax.
- All container startup and filesystem mounting is performed by LSF.
- The User never gains elevated privileges.
- Administrator Visibility of container use:
  - host, container name, tags, source repository, file path, size, install time, age, last used, last used by



HPC Administration in the Cloud Era

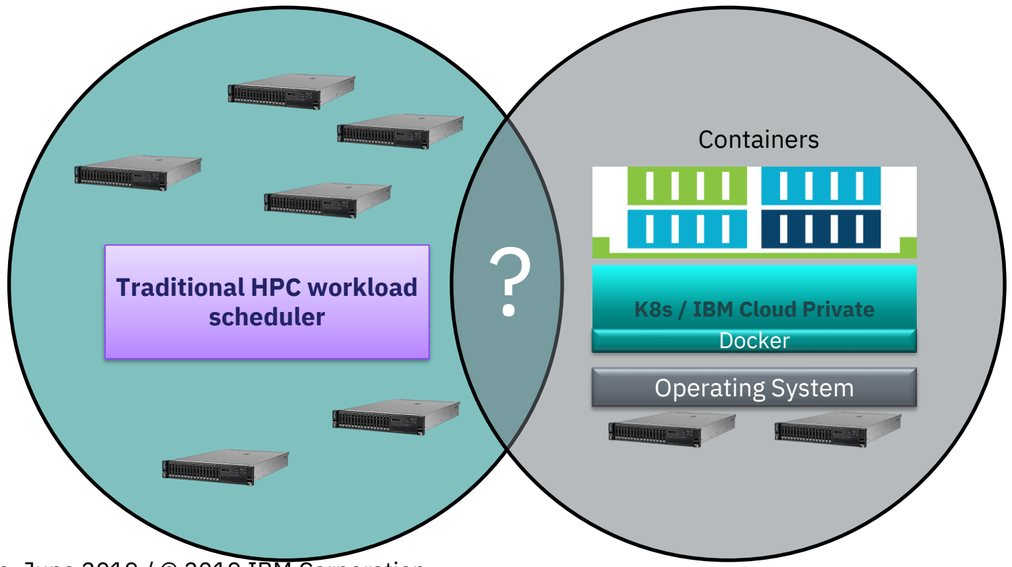
Numerous considerations and requirements to satisfy

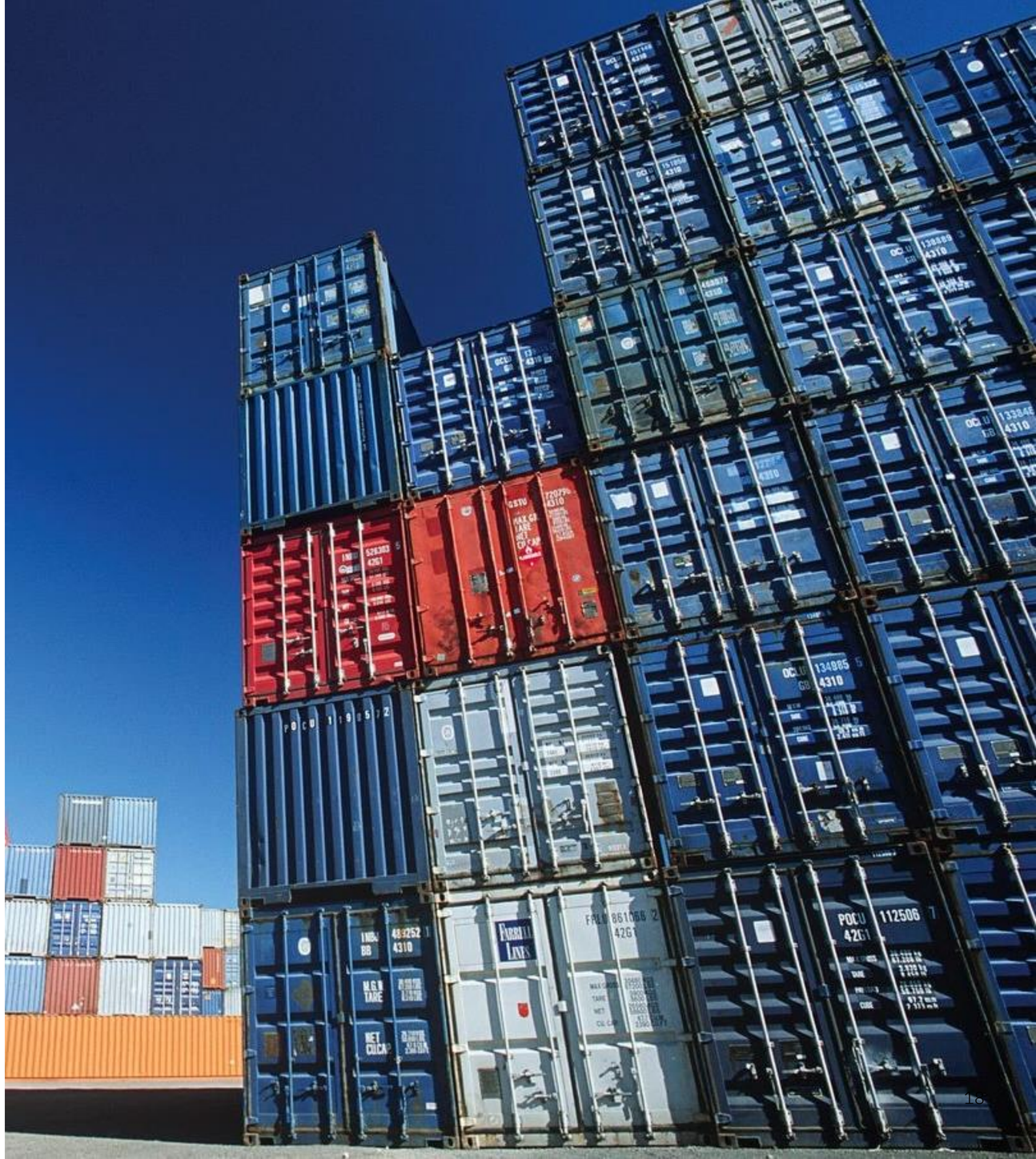
- I need to on-board cloud native workloads without disrupting my existing HPC cluster
- I need enable DevOps tools and processes for my users
- I need to provide a secure multi-user environment that doesn't sacrifice performance



HPC and Kubernetes

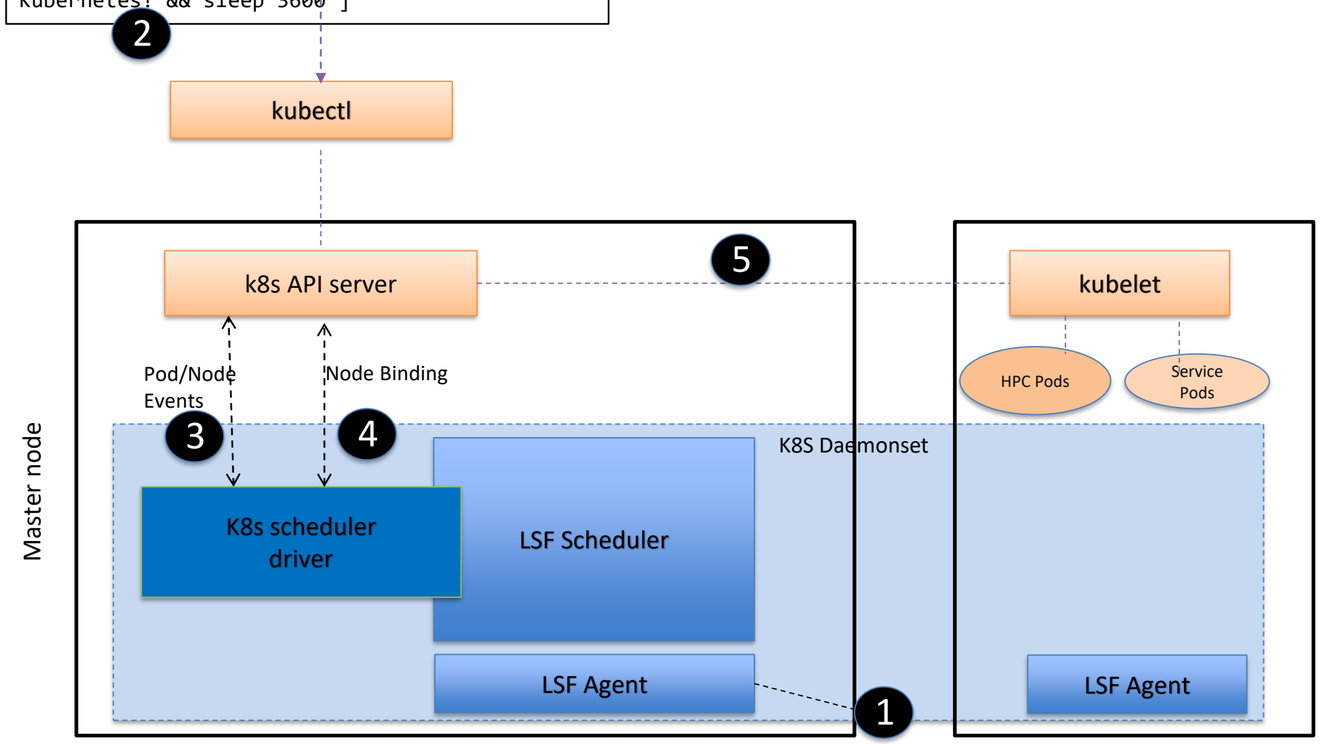
- Can k8s address all HPC use cases and negate the need for a traditional workload scheduler?
- While many high performance computing workloads can be containerized, they expect various services to be available in the environment – containerizing these can be challenging.
- How to integrate k8s with a traditional workload scheduler to get the best of both worlds?





Deployment Option #1: LSF as a pod scheduler in a pure K8S environment

```
apiVersion: v1
kind: Pod
metadata:
  name: myapp-pod
  labels:
    app: myapp
  annotations:
    lsf.ibm.com/queue: “night”
    lsf.ibm.com/fairshareGroup: “project-1”
    lsf.ibm.com/gpu: ”gpu=4:mode=shared”
spec:
  schedulerName: lsf
  containers:
    - name: myapp-container
       image: busybox
       command: ['sh', '-c', 'echo Hello
Kubernetes! && sleep 3600']
```



K8S native user experience

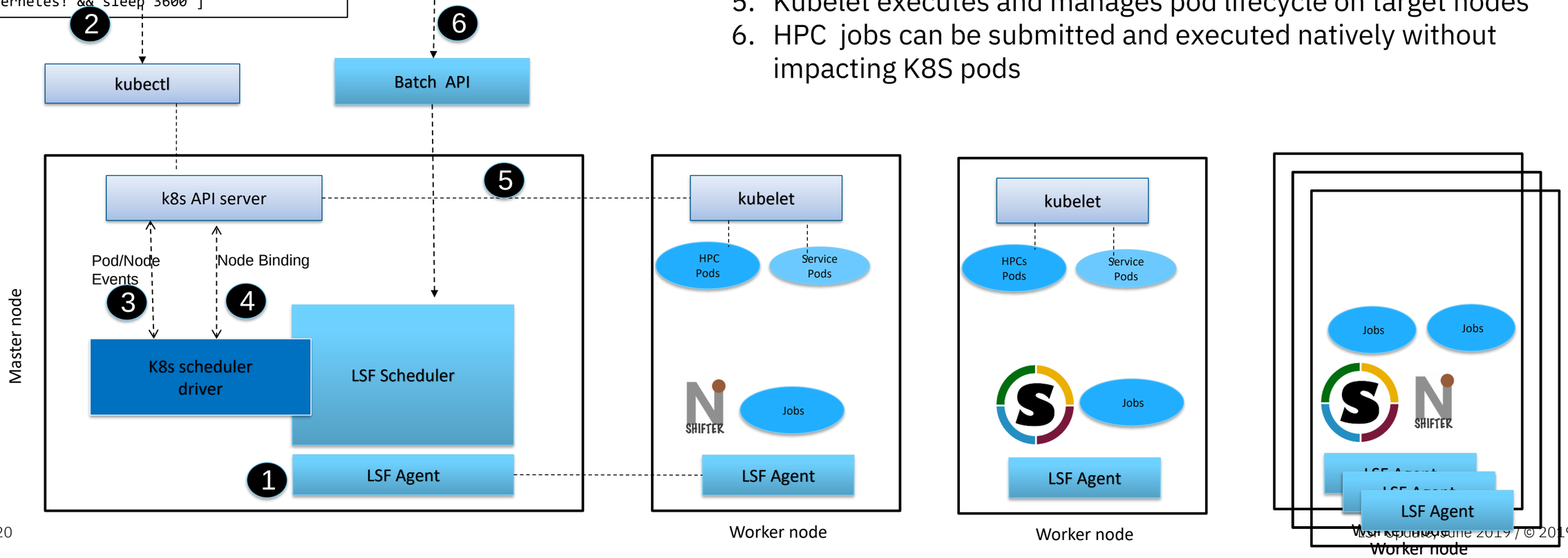
1. HPC Scheduler components are deployed as DaemonSet in K8S via Helm chart
2. Users submit workload into K8S API annotating pods with scheduler directives
3. Driver listens to API servers and translates pod requests into jobs in HPC Scheduler
4. HPC Scheduler makes decisions to bind pod to specific node based on policy
5. Kubelet executes and manages pod lifecycle on target nodes

Deployment Option #2: Existing Spectrum LSF augmented with Kubernetes

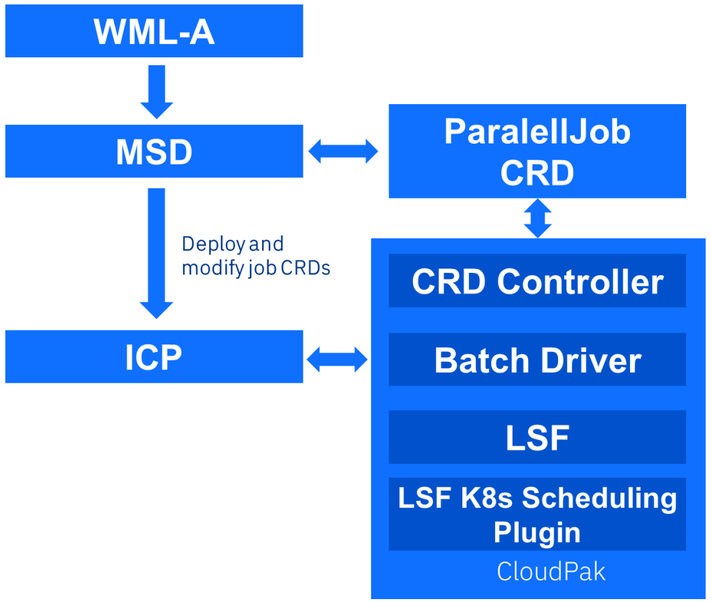
```
apiVersion: v1
kind: Pod
metadata:
  name: myapp-pod
  labels:
    app: myapp
  annotations:
    lsf.queue: “night”
    lsf.fairshareGroup: “project-1”
    lsf.ibm.com/gpu: ”gpu=4:mode=shared”
spec:
  schedulerName: lsf
  containers:
    - name: myapp-container
      image: busybox
      command: ['sh', '-c', 'echo Hello
Kubernetes! && sleep 3600']
```

```
bsub –app singularity –n 5,10
mpijob.sh
```

1. LSF runs on bare OS, and connects to a k8s API server. LSF cluster can be larger than K8S nodes (>5000 nodes)
2. Users submit workload into K8S API annotating pods with scheduler directives
3. Driver listens to API servers and translates pod requests into jobs in LSF Scheduler
4. LSF Scheduler makes decisions to bind pod to specific node based on policy
5. Kubelet executes and manages pod lifecycle on target nodes
6. HPC jobs can be submitted and executed natively without impacting K8S pods



Watson Machine Learning Accelerator Use Case




```
apiVersion: scheduling.batch/v1alpha1
kind: ParallelJob
metadata:
  name: large_model_train
  namespace: default
  annotations:
    lsf.ibm.com/queue: myQueue
spec:
  name: large_model_train #same with metadata/name
      description: This is a parallel job to run model training across hosts.
  priority: 100
  headerTask: group0
  placement:
    sameTerm: Zone | Rack | Host
  taskGroups:
  - metadata:
      name: parameter_server
    spec:
      replica: 1
      template:
        spec:
          containers:
            image: ubuntu
            resources:
              request:
                cpu: 1
                memory: 4096Mi
```

LSF specific annotations

Job level specification

Task level specification

```
- metadata:
    name: worker_nodes
    annotations:
      lsf.ibm.com/gpu: nvlink=yes
  spec:
    placement:
      spanTerm:
        - topologyKey: node
        taskTile: 2
        - topologyKey: node
        taskTile: 4
    replica: 4
    template:
      spec:
        containers:
          image: nvida/cuda9.2
          name: task1
          resources:
            request:
              nvidia.com/gpu: 2
              memory: 16000Mi
```

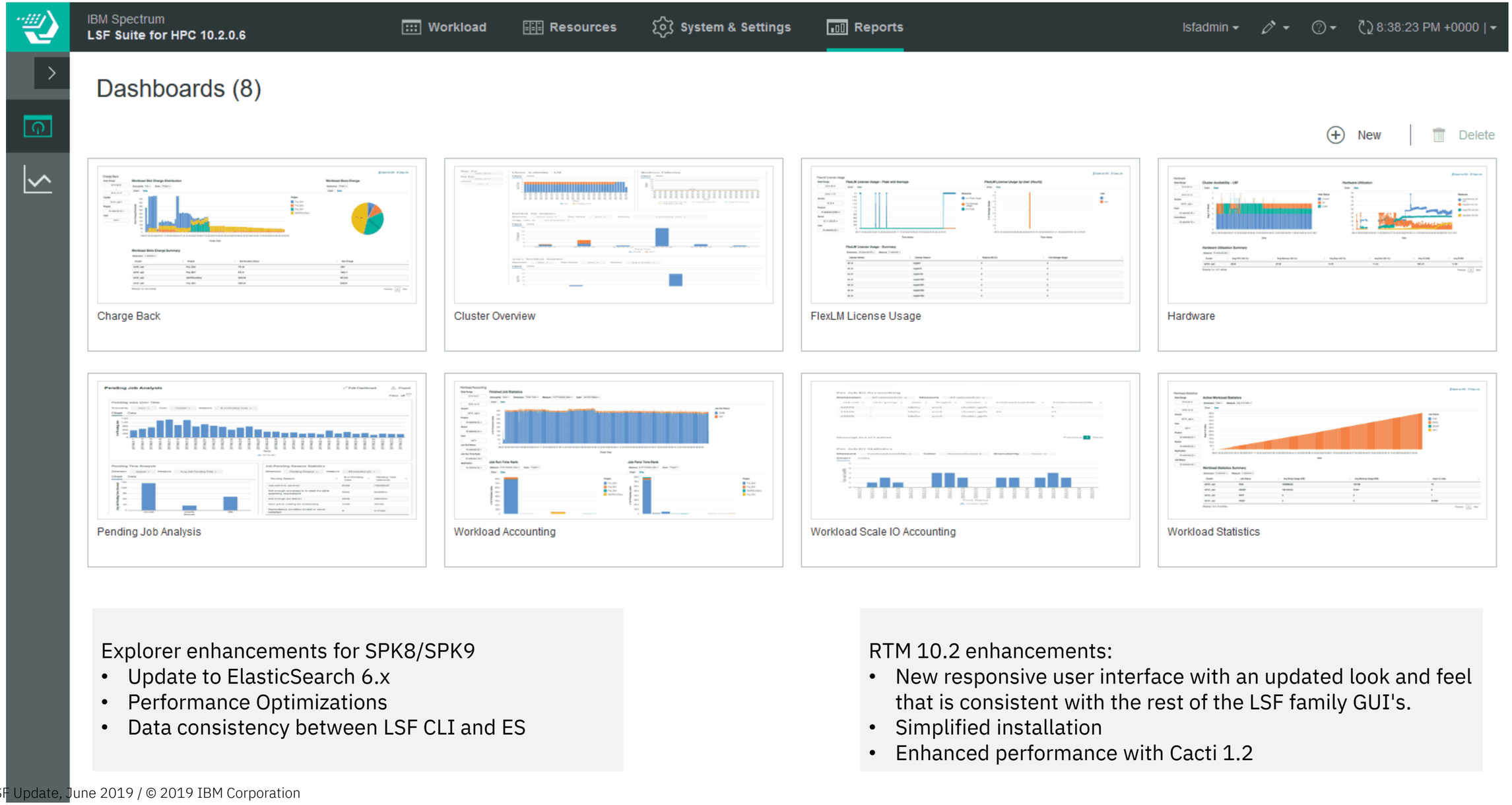
IBM Spectrum LSF

http://ibm.biz/SpectrumComputing_CloudPak_preview

IBM

IBM Spectrum Computing

Management visibility LSF Explorer & LSF RTM



Explorer enhancements for SPK8/SPK9

- Update to ElasticSearch 6.x
- Performance Optimizations
- Data consistency between LSF CLI and ES

RTM 10.2 enhancements:

- New responsive user interface with an updated look and feel that is consistent with the rest of the LSF family GUI's.
- Simplified installation
- Enhanced performance with Cacti 1.2