

Broadening Moab/TORQUE for Expanding User Needs

Gary D. Brown
HPC Product Manager

CUG 2016

Agenda

- DataWarp
- Intel MIC “KNL”
- Viewpoint Web Portal
 - User Portal
 - Administrator Portal
 - Remote Visualization
 - Nitro HTC

Agenda

- **DataWarp (fast I/O)**
- Intel MIC “KNL”
- Viewpoint Web Portal
 - User Portal
 - Administrator Portal
 - Remote Visualization
 - Nitro HTC

Use Cases

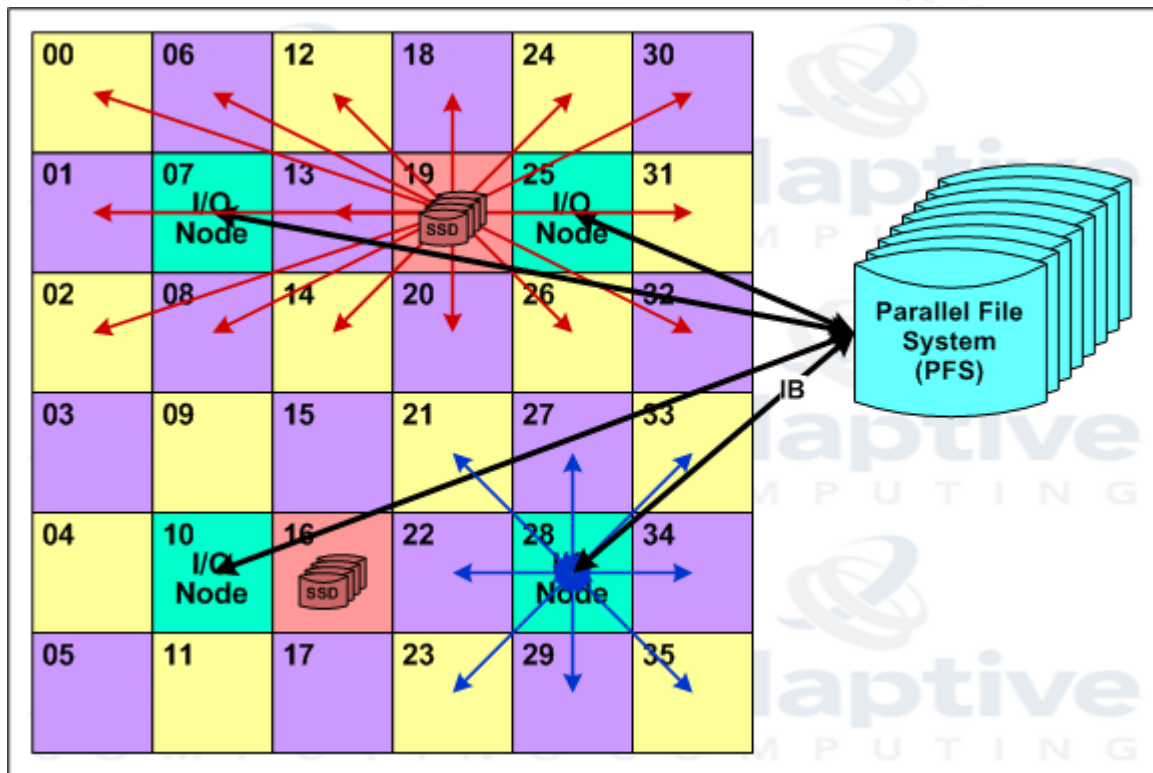
- Stage job data with fast SSD-based storage
 - Input data before job starts
 - Output data after job ends
- Fast persistent storage for job workflows
- Fast job checkpoint/restore

Cray DataWarp

- SSD-based storage system independent of parallel file system (PFS)
- Hosted on DataWarp (DW) service nodes
 - Contain actual SSDs
 - Nodes connect to Aries high-speed network
- DataWarp Service (DWS)
 - Organizes DW storage for jobs and persistent storage
 - Manages SSD storage across DW service nodes

Cray DataWarp Physical Architecture

- **DW storage**
 - 2-hop roundtrip
 - Aries HSN
 - Electronic access times
- **PFS storage**
 - 4-hop roundtrip
 - 2-hop Aries HSN
 - 2-hop InfiniBand
 - Electro-mechanical access times
- *DWS not shown*



Cray DataWarp Support

- DataWarp Storage Types
 - Job-based
 - Persistent
- Script-based integration with Moab/TORQUE
- DW-enabled jobs processed by Moab “job submit filter”
- Moab automatically creates DW job workflow

DataWarp Integration Project

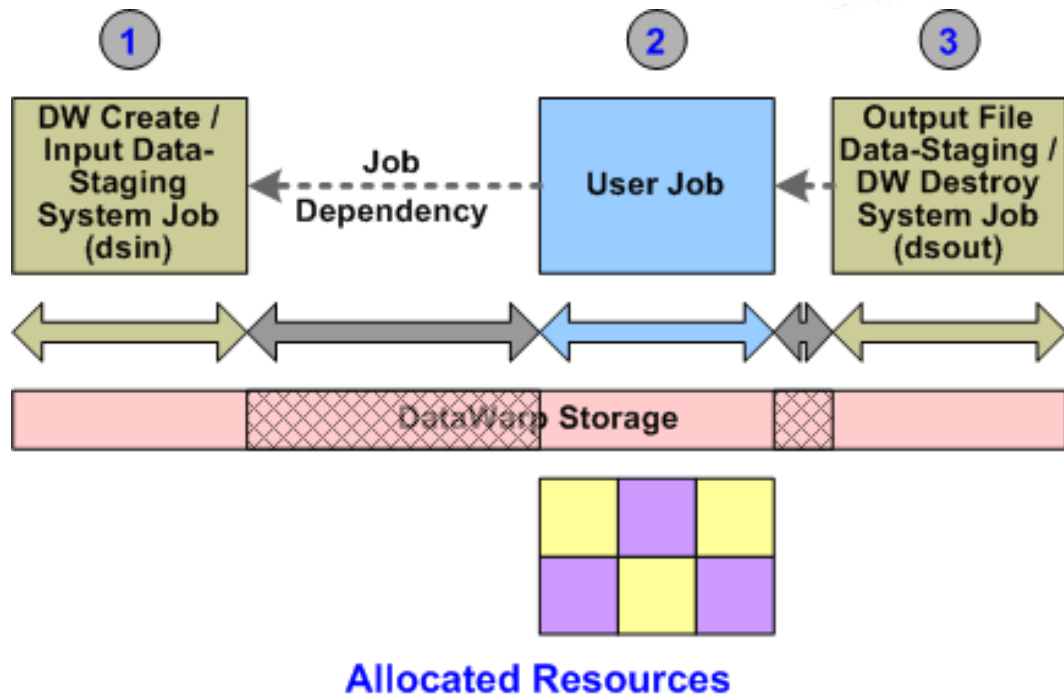
- All DW storage scheduled by Moab
 - Job DW storage by job scheduling
 - Persistent DW storage by reservation scheduling
- Out-of-the-box functionality
 - Some site-specific information configuration required

Moab 3-Job DataWarp Model

- Follows Moab Data-staging Model
 - Uses Moab “system” jobs to create/destroy DW storage and stage data in/out
- Automatically creates 3-job workflow
 - DW creation/input data-staging system job
 - User job
 - Output data-staging/DW destruction system job

DataWarp-enabled Job Workflow

- User submits user job
- Job Submit Filter detects #DW directives
- Job Submit Filter creates 3-job workflow
 1. DW Creation / Input Data-staging System job
 2. User Job
 3. Output Data-staging / DW Destruction System Job

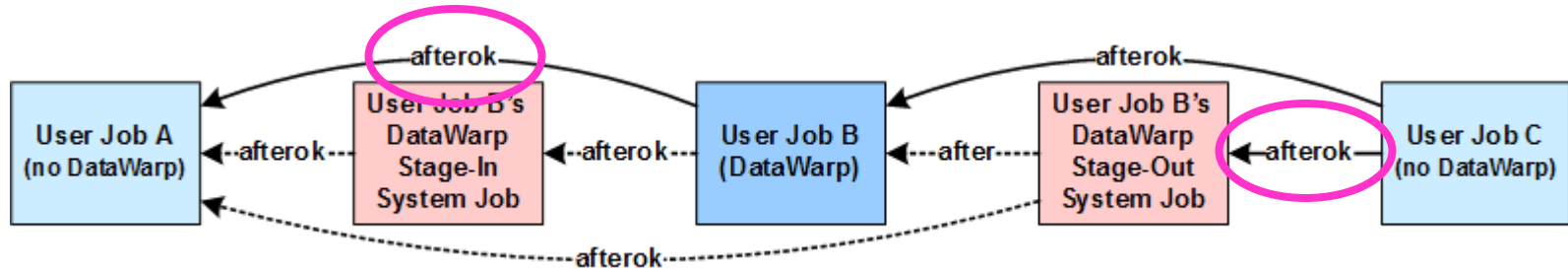


Automatic Job/DW Workflow Generation

- What if user submits multiple-job workflow
 - And some user jobs in job workflow use DataWarp storage?
- Job Submit Filter creates proper DW job dependencies, but not for entire user job workflow
- Example
 - Data validation *User Job A*
 - Compute (uses DataWarp) *User Job B (DW)*
 - Visualization *User Job C*

Automatic Job/DW Workflow Generation

- User Job Dependencies
 - Data validation User Job A
 - Compute User Job B (*DataWarp-enabled job*)
 - Visualization User Job C
 - Job A (ok) ← Job B (ok) ← Job C
- Job workflow generation script must work with Job Submit Filter to create proper job dependencies (*solid lines below*)



Multi-Job Workflow Generation Script

Submit data validation job A

```
jobAid=`msub -l nodes=1,walltime=10:00 myCheck.sh`
```

Submit DataWarp-enabled compute job B

(3 jobids returned (dwin, user, dwout); put into array)

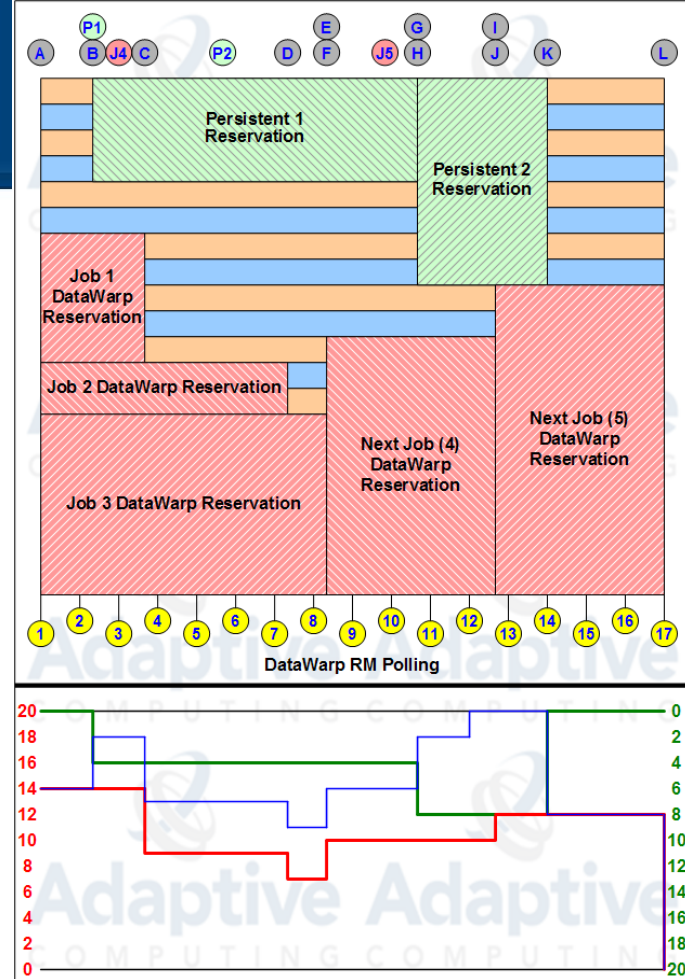
```
jobBids=(`msub -l nodes=16,walltime=01:30:00,\  
          depend=afterok:${jobAid} ...\  
          mySim.sh`)
```

Submit visualization job C

```
jobCid=`msub -l nodes=1,walltime=30:00,\  
        depend=afterok:${jobBids[1]}:${jobBids[2]} \  
        myViz.sh`
```

Persistent DataWarp Storage

- Moab schedules and tracks all DW storage capacity
- Moab persistent DW storage uses DW storage reservation
- Persistent DataWarp storage management
 - Created by reservation start trigger
 - Destroyed by reservation end trigger
- Jobs get mount point



Benefits

- Moab schedules and manages both job and persistent DataWarp storage
- Users have good user experience
 - *No race conditions cause cancelled jobs!*
- Jobs have fast I/O
- Jobs execute in less time

Agenda

- DataWarp
- **Intel MIC “KNL” (re-provisioning)**
- Viewpoint Web Portal
 - User Portal
 - Administrator Portal
 - Remote Visualization
 - Nitro HTC

Use Case

- Intel introduces 2nd-gen Xeon Phi processor
- KNL supports
 - 3 different NUMA configurations with 5 modes
 - 3 different MCDRAM configurations with 4 modes
 - 20 possible NUMA/MCDRAM configurations
- Some applications execute fastest with specific NUMA/MCDRAM configuration

Intel MIC “Knights Landing” (KNL)

- 5 NUMA configurations for cores and DDR4 and MCDRAM memories
 - No NUMA (all2all, hemisphere, quadrant) and sub-NUMA cluster 2 and 4
 - *a2a, hemi, quad, snc2, snc4*
- 4 MCDRAM “mode” configurations
 - Cache, flat, 50/50 hybrid, 25/75 hybrid
 - *cache, flat, equal, split*

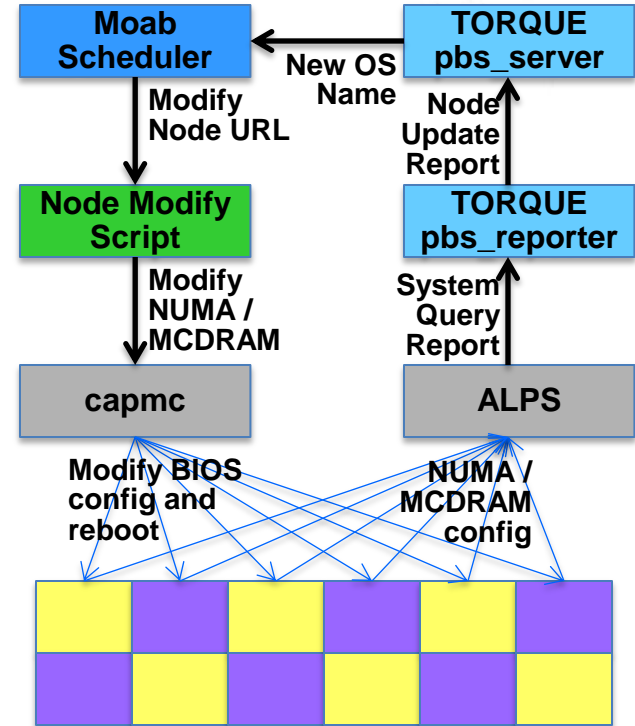
Moab Cray KNL Support

- 20 pre-defined combinations
 - Select combination as "OS" at job submission
`msub nodes=20,os=CLE_snc4_flat myJobScript`
- Moab re-provisions Cray compute nodes when necessary
 - Uses Moab's built-in re-provisioning capability
 - Quickly re-provisions Cray KNL compute nodes for jobs requesting specific NUMA/MCDRAM modes

Cray KNL Re-provisioning Process

- User submits job requiring specific KNL NUMA / MCDRAM configuration

```
msub -l nodes=20,os=CLE_snc4_flat myJob
```
- Moab schedules KNL job to nodes
- Moab runs NodeModifyURL script to modify compute node configurations and reboot them
- Script executes Cray capmc to set KNL NUMA node and MCDRAM configurations and to reboot nodes
- Cray's capmc modifies nodes' BIOS settings and reboots nodes
- Cray reports new NUMA node / MCDRAM configurations
- pbs_reporter maps NUMA node/MCDRAM configuration to OS name and reports OS name to pbs_server
- TORQUE pbs_server passes new OS name to Moab, which starts the KNL job



Benefits

- Users can run applications with KNL NUMA and MCDRAM configuration for optimal job execution.
- Easy to request specific KNL configuration with job submission

Agenda

- DataWarp
- Intel MIC “KNL”
- **Viewpoint Web Portal (non-technical users)**
 - User Portal
 - Administrator Portal
 - Remote Visualization
 - Nitro HTC

Use Case

- Many HPC sites asked to expand user base
- Non-technical users
 - “What is a command line?”
- Non-traditional users
 - Non-research Engineers and Scientists
 - Humanities
 - Local or regional industries with no HPC experience

Agenda

- DataWarp
- Intel MIC “KNL”
- Viewpoint Web Portal (non-technical users)
 - **User Portal (job submission)**
 - Administrator Portal
 - Remote Visualization
 - Nitro HTC

Use Case

- Someone said I need to use “xyz” program
- I have data
 - Someone gave me my data
 - Someone mentored/trained me and I created my own data
 - I taught myself and created my own data
- How do I use “xyz” with my data?

Log in as user to Viewpoint Web Portal

The image shows a web browser window with the following elements:

- Browser Tab:** Viewpoint Login
- Address Bar:** 10.2.184.78:8081/login/
- Page Header:** Moab VIEWPOINT
- Login Form:**
 - Title:** Login
 - Username Field:** hpotter
 - Password Field:** Masked with 8 dots
 - Login Button:** LOGIN

Click Templates on your User Dashboard

The screenshot shows the Moab Viewpoint user dashboard. The top navigation bar includes the Moab Viewpoint logo, the user name 'hpotter', and a 'Sign Out' link. Below the navigation bar are tabs for HOME, WORKLOAD, TEMPLATES, FILE MANAGER, and SESSIONS. The WORKLOAD tab is active. A search bar is located at the top left of the main content area. Below the search bar, there is a 'Workload' section with a refresh interval set to 15s and a 'CREATE JOB' button. A table lists various jobs with columns for Job ID, Job Name, Submitter ID, Start Date, Submit Date, Queue Status, Cores, Nodes, and Wall Clock. To the right of the table is a 'Workload Summary' card titled 'ALL JOBS IN A COMPLETED STATE'. The card features a donut chart showing 10 completed jobs (100%) and a 'View All Workload' button.

nt_demo Viewpoint Dashboard 10.2.184.78:8081/dashboard/ Search

Welcome, hpotter Sign Out ?

HOME WORKLOAD TEMPLATES FILE MANAGER SESSIONS

Search

Workload Refresh Interval 15s CREATE JOB

Job ID	Job Name	Submitter ID	Start Date	Submit Date	Queue Status	Cores	Nodes	Wall Clock
Moab.113	paraview	hpotter	2016-04-19 10:22:13	2016-04-19 10:22:06	COMPLETED	4	1	00:12:00:00
Moab.112	ansys	hpotter	2016-04-19 10:13:39	2016-04-19 10:13:30	COMPLETED	1	1	00:01:00:00
Moab.111	opendtect	hpotter	2016-04-13 06:48:14	2016-04-13 06:48:06	COMPLETED	2	1	00:01:00:00
Moab.110	paraview	hpotter	2016-04-13 06:06:40	2016-04-13 06:06:32	COMPLETED	4	1	00:12:00:00
Moab.109	Nitro_job	hpotter	2016-04-12 12:25:34	2016-04-12 12:25:27	COMPLETED	8	1	00:01:00:00
Moab.108	Nitro_job	hpotter	2016-04-12 12:20:10	2016-04-12 12:20:00	COMPLETED	8	1	00:01:00:00
Moab.107	paraview	hpotter	2016-04-12 12:15:17	2016-04-12 12:15:10	COMPLETED	4	1	00:12:00:00
Moab.106	desktop	hpotter	2016-04-12 12:12:51	2016-04-12 12:12:44	COMPLETED	1	1	00:12:00:00

Workload Summary

ALL JOBS IN A COMPLETED STATE

COMPLETED 10 (100%)

View All Workload

Use "xyz" application template

The screenshot shows the Moab Viewpoint web interface. The browser address bar displays `10.2.184.78:8081/dashboard/`. The page header includes the Moab Viewpoint logo, the user name "Welcome, hpotter", and a "Sign Out" link. The navigation menu contains "HOME", "WORKLOAD", "TEMPLATES", "FILE MANAGER", and "SESSIONS".

The "Workload" section is active, showing a table of jobs. A "Select Application Template" dialog box is open, displaying a list of template types. The "HPC Application" option is selected. The dialog also shows a list of application templates with their creation dates and administrators.

Job ID	Job Name	Submitter
Moab.113	paraview	hpotter
Moab.112	ansys	hpotter
Moab.111	opendtect	hpotter
Moab.110	paraview	hpotter
Moab.109	Nitro_job	hpotter
Moab.108	Nitro_job	hpotter
Moab.107	paraview	hpotter
Moab.106	desktop	hpotter

Template Type	Template Name	Date	Admin
All	All		
ANSYS	HPC Application	2016/4/12	moab-admin
	Job Array		
Docker App	Remote Visualization		
	Nitro Application		
	Desktop	2016/3/15	moab-admin
	Nitro Application	2016/4/8	moab-admin

Fill in application template



Create Job

ANSYS

Basic Settings

Basic Job Settings

Name

Time Management

Duration

Credentials

Account

Queue / Class

Resources

Number of Cores

Total Memory (GB)

Total Cores

Choose a time limit

The screenshot shows a web browser window with the address bar containing the URL `10.2.184.78:8081/create_job/?t=http://10.2.184.78:8081/api/templates/62/`. The page title is "Create Job". The main content area is titled "Basic Settings" and is divided into several sections:

- Basic Job Settings:** Name: `ansys`
- Credentials:** Account: `engineering`, Queue / Class: `batch`
- Resources:** Number of Cores: `Total Amount of Cores`, Total Cores: `1`, Total Memory (GB): `4.00`
- Data Management:** Error Path: `/home/hpotter`
- Time Management:** Duration: `1:00:00`. A tooltip above the input shows "1 hour". A numeric keypad is visible below the input, showing `0` w `0` d `1` : `0` : `0`.

Tell it where your data file is

The image shows a web browser window with a URL bar containing `10.2.184.78:8081/create_job?t=http://10.2.184.78:8081/api/templates/62/`. The page title is "Create Job". The main content area is a form for job configuration with the following fields:

- Number of Cores: Total Amount of Cores (dropdown)
- Total Cores: 1
- Total Memory (GB): 4.00
- Data Management: Error Path (/home/...)
- ANSYS Settings: Version (14), Data File (empty)

An "Open File" dialog box is overlaid on the form, showing a file browser for the path `Remote File System / home / hpotter / ansys`. The dialog contains a table of files:

Name	Date
ansys.in	2016/03/15
ansys.out	2016/04/19

The dialog also includes a "Show 10 entries" control and a "SELECT" button at the bottom right.

Submit your "xyz" job

Browser tabs: Create Job

Address bar: 10.2.184.78:8081/create_job/?t=http://10.2.184.78:8081/api/templates/62/

Search: Search

Number of Cores: Total Amount of Cores

Total Cores: 1

Total Memory (GB): 4.00

Data Management

Error Path: /home/hpotter

ANSYS Settings

Version: 14

Data File: /home/hpotter/ansys/ansys.in [Browse...]

Output Data File: /home/hpotter/ansys/ansys.out [Browse...]

Buttons: Cancel, CREATE

Notification: Job with ID "Moab.114" has been submitted

Click Workload to check on your "xyz" job

The screenshot shows a web browser window with the URL `10.2.184.78:8081/jobdetails/?job_name=Moab.114&job_id=Moab.114`. The page header includes the Moab Viewpoint logo, a user greeting "Welcome, hpotter", and a notification: "Job status has been changed to 'RUNNING'". The navigation menu contains "HOME", "WORKLOAD", "TEMPLATES", "FILE MANAGER", and "SESSIONS". The main content area displays "Job Details" with a refresh icon, a "Return to earlier search" link with a "Cancel" button, and the job status "Status: ACTIVE" and "Job Status: RUNNING". The job details list includes: Job Id: Moab.114 (ansys), Submission Script: N/A, Reservation Name: N/A, and Template: ANSYS (v.6 CURRENT). A "Job Messages" section is partially visible. Below, the "Credentials" section shows: User hpotter, Group hpotter, Account engineeri..., Class batch, and Quality of Service None. The "CPU Statistics" section contains a loading spinner.

Moab VIEWPOINT

Welcome, hpotter

Job status has been changed to "RUNNING".

HOME WORKLOAD TEMPLATES FILE MANAGER SESSIONS

Job Details

Return to earlier search

Status: **ACTIVE**
Job Status: **RUNNING**

Job Id : Moab.114 (ansys)
Submission Script: N/A
Reservation Name: N/A
Template: **ANSYS (v.6 CURRENT)**

Job Messages

Credentials

User hpotter	Group hpotter	Account engineeri...
Class batch	Quality of Service None	

CPU Statistics

Check out your "xyz" job's details

The screenshot shows a web browser window with the title 'Viewpoint Job Details'. The address bar contains the URL '10.2.184.78:8081/jobdetails/?job_name=Moab.114&job_id=Moab.114'. A search bar is visible with the text 'Search'. Below the browser window, a progress bar shows a timeline from 0.00 to 10:35, with a red bar indicating progress up to approximately 10:33. The main content area is divided into several sections: 'Time Frame', 'Data Management', 'Other Information', and 'Resource Requirement Summary'. The 'Time Frame' section contains a table with columns for Start Time, Duration, Completion Time, and Actual Duration. The 'Data Management' section lists Execution Path, Output Path, and Error Path, all pointing to '/home/hpotter'. The 'Other Information' section lists Partition Access List (None) and Start Count (1). The 'Resource Requirement Summary' section lists Total Processors Requested (1), Total Memory Requested (4.0 GB), Total Swap Requested (N/A), Total Disk (N/A), Total Nodes Requested (0), Allocated Node List (toi-901.vapor2.ac.localdomain), Allocated Node Count (1), and Allocated Partition (demo).

10.2.184.78:8081/jobdetails/?job_name=Moab.114&job_id=Moab.114

0.00 10:33 10:34 10:35

Time Frame

Start Time	Duration	Completion Time	Actual Duration
2016-04-19 10:33:55	00:00:01:00	None	00:00:00:22

Data Management

Execution Path	/home/hpotter	...
Output Path	/home/hpotter	...
Error Path	/home/hpotter	...

Other Information

Partition Access List	None
Start Count	1

Resource Requirement Summary

Total Processors Requested	1	Total Nodes Requested	0
Total Memory Requested	4.0 GB	Allocated Node List	toi-901.vapor2.ac.localdomain
Total Swap Requested	N/A	Allocated Node Count	1
Total Disk	N/A	Allocated Partition	demo

Look at your job's statistics

The screenshot displays the Moab Viewpoint web interface. At the top, the browser address bar shows the URL `10.2.184.78:8081/jobdetails/?job_name=Moab.114&job_id=Moab.114`. The page header includes the Moab Viewpoint logo, a user greeting "Welcome, hpotter", and a "Sign Out" link. A navigation menu contains "HOME", "WORKLOAD", "TEMPLATES", "FILE MANAGER", and "SESSIONS".

The main content area is titled "Job Details" and includes a refresh icon. On the right, there is a "Return to earlier search" link and a "Cancel" button. The job status is prominently displayed as "Status: ACTIVE" in green, with "Job Status: RUNNING" below it.

Job details listed include:
Job Id: Moab.114 (ansys)
Submission Script: N/A
Reservation Name: N/A
Template: ANSYS (v.6 CURRENT)

A "Job Messages" section is visible below the details.

On the left, a "Credentials" section shows:
User: hpotter, Group: hpotter, Account: engineeri...
Class: batch, Quality of Service: None

On the right, a "CPU Statistics" chart is shown. The chart is a stacked bar with a Y-axis labeled "CPU Count" ranging from 0.00 to 1.00. The legend indicates "Dedicated CPUs" (blue) and "Utilized CPUs" (red). The bar for job ID 83 shows approximately 0.75 Utilized CPUs and 0.25 Dedicated CPUs. A settings gear icon is located in the top right corner of the chart area.

Job ID	Utilized CPUs	Dedicated CPUs
83	0.75	0.25

Download your "xyz" job's results

The screenshot shows a web browser window displaying the Moab Viewpoint File Manager interface. The browser's address bar shows the URL `10.2.184.78:8081/file-manager/?path=/home/hpotter`. The Moab Viewpoint header includes a navigation menu with **HOME**, **WORKLOAD**, **TEMPLATES**, **FILE MANAGER** (selected), and **SESSIONS**. A user greeting "Welcome, hpotter" and a "Sign Out" link are visible in the top right.

The File Manager section shows a breadcrumb path: `Remote File System / home / hpotter`. On the right side of this section, there are buttons for **Upload**, **New Folder**, and a **Name** dropdown menu.

The main content area displays a grid of files and folders. A context menu is open over the file `compressed-a...` in the `ansys/` folder. The menu options are:

- Download
- Uncompress
- Copy
- Move
- Rename
- Delete
- Permissions

Other visible files and folders include:

- `ansys/` folder (2016/03/15)
- `nitro/` folder (2016/03/15)
- `paraview/` folder (2016/03/15)
- `software/` folder (2016/03/15)
- `compressed-a...` file (4.01 KB, 2016/04/19)
- `nitrotask100k...` file (878.91 KB, 2016/03/18)
- `nitrotask10k.txt` file (87.89 KB, 2016/04/01)

Benefits

- Allows non-technical users to submit jobs using pre-defined application templates
- Application templates contain
 - Job script for running application
 - Web form design with pre-defined and/or custom widgets and their variables
 - Job submission replaces variables within job script with form's widget values

Agenda

- DataWarp
- Intel MIC “KNL”
- Viewpoint Web Portal (non-technical users)
 - User Portal
 - **Administrator Portal (application templates)**
 - Remote Visualization
 - Nitro HTC

Use Case

- Administrator needs to support many non-technical users and their applications
- Define application templates using editor
 - Define and customize application template form using pre-defined “widget” types
 - Define widgets’ variable name, default value, and other characteristics to build form
 - Create job script

Log in as admin to Viewpoint Web Portal

Connecting... x +

10.2.184.78:8081/login/ x Search ☆ 📁 🛡️ ⬇️ 🏠 🗨️ ☰

Moab VIEWPOINT

Login

moab-admin

••••••••

LOG IN

Click on Templates in Admin Dashboard

The screenshot shows a web browser window with the URL `10.2.184.78:8081/dashboard/`. The page title is "Moab VIEWPOINT". The navigation bar includes "HOME", "WORKLOAD", "TEMPLATES", "NODES", "FILE MANAGER", "SESSIONS", and "CONFIGURATION". The "TEMPLATES" menu item is highlighted. Below the navigation bar, there is a search bar and a "Refresh Interval" dropdown set to "15s". The main content area displays a "Workload" table with columns for Job ID, Job Name, Submitter ID, Start Date, Submit Date, Queue Status, Cores, Nodes, and Wall Clock. The table lists several jobs, including "job54196", "Moab.114", "job54195", "job54194", "job54193", "job54192", "job54190", and "job54191". On the right side, there are two summary cards: "Dedicated System Resources" showing CPU and MEMORY usage, and "Node Summary" showing 23 nodes with a breakdown of Idle, Busy, and Down states.

Moab VIEWPOINT

Welcome, moab-admin [Sign Out](#) ⚙️ ?

HOME WORKLOAD **TEMPLATES** NODES FILE MANAGER SESSIONS CONFIGURATION

Search

Refresh Interval 15s

Workload

Job ID	Job Name	Submitter ID	Start Date	Submit Date	Queue Status	Cores	Nodes	Wall Clock
job54196	None	jfoote	N/A	2016-04-19 10:33:49	ELIGIBLE	1	0	00:02:00:00
Moab.114	ansys	hpotter	2016-04-19 10:33:55	2016-04-19 10:33:48	COMPLETED	1	1	00:00:01:00
job54195	None	ufelton	N/A	2016-04-19 10:33:47	ELIGIBLE	1	0	00:05:33:20
job54194	None	tgates	N/A	2016-04-19 10:33:41	ELIGIBLE	1	0	00:01:00:00
job54193	None	eval6	N/A	2016-04-19 10:27:58	ELIGIBLE	1	0	00:22:13:20
job54192	None	gastor	N/A	2016-04-19 10:27:21	ELIGIBLE	1	0	00:01:00:00
job54190	None	tamaker	N/A	2016-04-19 10:26:50	ELIGIBLE	1	0	00:01:00:00
job54191	None	tamaker	N/A	2016-04-19 10:26:50	ELIGIBLE	1	0	00:01:00:00

Dedicated System Resources

CPU MEMORY

100

60

24h... Current

Node Summary

23 NODES

● IDLE ● BUSY ● DOWN

2

Choose an application template

Application Templates

10.2.184.78:8081/templates/

Moab VIEWPOINT

Welcome, moab-admin [Sign Out](#)

HOME WORKLOAD **TEMPLATES** NODES FILE MANAGER SESSIONS CONFIGURATION

Application Templates

Template Type: All

Name	Ver.	Owner	Permissions	Published	Used	Changed
ANSYS	v.6	moab-admin	Users: ALL Groups: ALL Accounts: ALL		17	2016-04-12
Calculator	v.2	moab-admin	Users: hpotter Groups: None Accounts: None		0	2016-03-14
Desktop	v.6	moab-admin	Users: ALL Groups: ALL Accounts: ALL		16	2016-03-15
Docker Application	v.3	moab-admin	Users: ALL Groups: ALL Accounts: ALL		0	2016-03-02
Free Form	v.3	moab-admin	Users: ALL Groups: ALL Accounts: ALL		4	2016-03-03
Job Array Calculator	v.2	moab-admin	Users: None Groups: hogwarts Accounts: None		0	2016-03-14
Nitro Application	v.6	moab-admin	Users: ALL Groups: ALL Accounts: ALL		26	2016-04-08
Opendtect (Oil&Gas)	v.6	moab-admin	Users: ALL Groups: ALL Accounts: ALL		10	2016-03-15

Filters

- Name -

- Owner -

- Published -

Date Created

Permissions

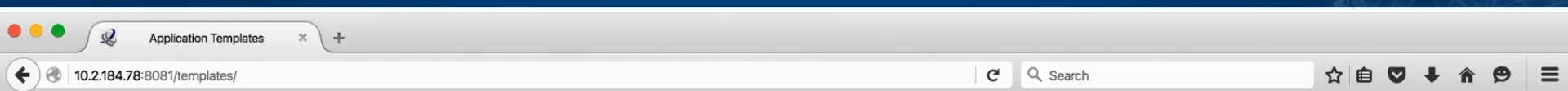
- User -

- Group -

- Account -

[RESET](#) [FILTER](#)

View application template history



Template History Manager

Name	Version	Changed By	Date	Description	Operations
ANSYS	v. 6 (CURRENT)	moab-admin	2016-04-12 12:07:39	(Reverted from v.4)	✕ ⬇
ANSYS	v. 5	moab-admin	2016-04-12 12:06:37		➡ ✕ ⬇
ANSYS	v. 4	moab-admin	2016-03-14 23:42:58		➡ ✕ ⬇
ANSYS	v. 3	moab-admin	2016-03-14 23:39:37		➡ ✕ ⬇
ANSYS	v. 2	moab-admin	2016-03-14 23:06:35		➡ ✕ ⬇
ANSYS	v. 1	N/A	2016-03-14 23:02:26		➡ ✕ ⬇

Show 10 entries

← prev 1 next →

Close

Show 10 entries

← prev 1 2 next →

Edit and design application template

The screenshot shows a web browser window with the URL `10.2.184.78:8081/job_templates/template_builder?url=http://10.2.184.78:8081/api/templates/62/`. The page title is "Template Builder". The Moab Viewpoint header includes the user "moab-admin" and a "Sign Out" link. The navigation menu contains: HOME, WORKLOAD, TEMPLATES, NODES, FILE MANAGER, SESSIONS, and CONFIGURATION.

Edit Application Template

ANSYS

Template Type: HPC Application

Version Description: (Reverted from v.4) [HISTORY](#)

Application Description: Visible

Basic Settings

Basic Job Settings | Time Management

Label	Name
Variable Name	NAME

Label	Duration
Variable Name	DURATION

Permissions

Users:

Groups:

Accounts:

Published Unpublished

Edit application template (lower part)

Application Description Visible

Basic Settings

Basic Job Settings

Time Management

Label	<input type="text" value="Name"/>	Label	<input type="text" value="Duration"/>
Variable Name	<input type="text" value="NAME"/>	Variable Name	<input type="text" value="DURATION"/>
Default Value	<input type="text" value="ansys"/>	Default Value	<input type="text" value="1:00:00"/>
<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Visible	<input checked="" type="checkbox"/> Editable	
<input checked="" type="checkbox"/> Enabled	<input checked="" type="checkbox"/> Visible	<input checked="" type="checkbox"/> Editable	

Groups

Accounts

Published Unpublished

EXPORT TEMPLATE

SAVE TEMPLATE

SAVE AND CLOSE

Choose Basic Job Settings widgets

<p>Label <input type="text" value="Name"/></p> <p>Variable Name <input type="text" value="NAME"/></p> <p>Default Value <input type="text" value="ansys"/></p> <p><input checked="" type="checkbox"/> Enabled <input checked="" type="checkbox"/> Visible <input checked="" type="checkbox"/> Editable</p>	<p>Label <input type="text" value="Duration"/></p> <p>Variable Name <input type="text" value="DURATION"/></p> <p>Default Value <input type="text" value="1:00:00"/></p> <p><input checked="" type="checkbox"/> Enabled <input checked="" type="checkbox"/> Visible <input checked="" type="checkbox"/> Editable</p>
<p>Label <input type="text" value="Submission Script"/></p> <p>Variable Name <input type="text" value="SCRIPT"/></p> <p>Default Value <input type="text" value="Customize Script"/></p> <p><input type="checkbox"/> Visible <input type="checkbox"/> Editable</p>	<p>Label <input type="text" value="Delay Start By"/></p> <p>Variable Name <input type="text" value="ELIGIBLEDATE"/></p> <p>Default Value <input type="text"/></p> <p><input type="checkbox"/> Enabled <input type="checkbox"/> Visible <input type="checkbox"/> Editable</p>
<p>Credentials <input type="text"/></p>	
<p>Label <input type="text" value="Account"/></p> <p>Variable Name <input type="text" value="ACCOUNT"/></p>	<p>Label <input type="text" value="Quality of Service"/></p> <p>Variable Name <input type="text" value="QOS"/></p>

EXPORT TEMPLATE

SAVE TEMPLATE

SAVE AND CLOSE

↑

↓

Choose Resources widgets

Resources

Label

Variable Name

Total Amount of Cores Visible

Total Cores

Nodes With Core Count Visible

Total Nodes

Cores Per Node

Enabled

Label

Variable Name

Default Value

Enabled Visible Editable

Label

Variable Name

Enabled Visible

Data Management

Label

Choose Node Policies Settings widgets

Node Policies Settings

Label Node Requested Policy	Label Node Access Policy
Variable Name NODESREQUESTEDPOLICY	Variable Name NODEACCESSPOLICY
Default Value Exact Set	Default Value Shared
<input type="checkbox"/> Enabled <input type="checkbox"/> Visible <input type="checkbox"/> Editable	<input type="checkbox"/> Enabled <input type="checkbox"/> Visible <input type="checkbox"/> Editable

Label Nodes Requested List	Label Node Allocation Policy
Variable Name NODESREQUESTED	Variable Name NODEALLOCATIONPOLICY
Default Value None	Default Value First Available
<input type="checkbox"/> Enabled <input type="checkbox"/> Visible <input type="checkbox"/> Editable	<input type="checkbox"/> Enabled <input type="checkbox"/> Visible <input type="checkbox"/> Editable

> ANSYS Settings

EXPORT TEMPLATE

SAVE TEMPLATE

SAVE AND CLOSE

Design custom "xyz" Settings widgets

ANSYS Settings

Type: List

Label: Version

Variable Name: VERSION

Label	Value
14	14
15	15

Visible Editable Required Delete

Type: Remote File

Label: Data File

Variable Name: INPUT

Visible Editable Required Delete

Type: Remote File

Label: Output Data File

Variable Name: OUTPUT

Visible Editable Required Delete

+ Left + Fill + Right

EXPORT TEMPLATE

SAVE TEMPLATE

SAVE AND CLOSE

↑

↓

Choose custom widget from widget type list

ANSYS Settings

Type: List

Label: Text Box, Text Area, Date Time, Number, Password, Radio Buttons, Check Box, List, Combo List, Slider, Remote File, Remote Directory, File Upload

Variable Name: Label, 14, 15

Visible Editable Required Delete

Type: Remote File

Label: Data File

Variable Name: INPUT

Visible Editable Required Delete

Type: Remote File

Label: Output Data File

Variable Name: OUTPUT

Visible Editable Required Delete

+ Left + Fill + Right

EXPORT TEMPLATE

SAVE TEMPLATE

SAVE AND CLOSE

Create/import job script with Script Builder

Basic Settings

Basic Job Settings

Label Name

Variable Name NAME

Default Value ansys

Enabled Visible Editable

Label Submission Script

Variable Name SCRIPT

Default Value Customize Script

Visible Editable

Published Unpublished

Script Builder

```
1 module load ansys/%VERSION%
2
3 cd $PBS_O_WORKDIR
4
5 # Copy input files to TMPDIR and then
6 # change working directory
7 cp %INPUT% $TMPDIR
8 cd $TMPDIR
9
10
11 /usr/bin/ansys%VERSION%0 -np %NUMOFCORES% -i
12
13 # Copy output files back to your working
14 # directory and clean up $TMPDIR
15 cp -r $TMPDIR $PBS_O_WORKDIR
16 rm -rf $TMPDIR
```

Variables

Moab Inputs

- ACCOUNT
- ARCHITECTURE
- DESTINATIONQUEUE
- DURATION
- ELIGIBLEDATE
- EMAILOPTIONS
- ENDINDEX
- ERRORPATH
- EXECUTIONDIRECTORY
- FEATURETAGS
- GENERICRESOURCES
- HOLD
- JOIN
- MAILLIST
- MEMORYPERNODE
- MOABENVIRONMENTVA...
- MOABTEMPLATE
- NAME
- NODEACCESSPOLICY

IMPORT EXPORT Cancel DONE EDITING

Add widget variables to job script

Basic Settings

Basic Job Settings

Label Name

Variable Name NAME

Default Value ansys

Enabled Visible Editable

Label Submission Script

Variable Name SCRIPT

Default Value Customize Script

Visible Editable

Script Builder

```
1 module load ansys/%VERSION%
2
3 cd $PBS_O_WORKDIR
4
5 # Copy input files to TMPDIR and then
6 # change working directory
7 cp %INPUT% $TMPDIR
8 cd $TMPDIR
9
10 echo |
11 %NAME% Variable
12 /usr %DURATION% Variable
13 %STARTINDEX% Variable
14 # Co %ENDINDEX% Variable
15 # di %ELIGIBLEDATE% Variable
16 cp - %USERPRIORITY% Variable
17 rm - %ACCOUNT% Variable
   %DESTINATIONQUEUE% Variable
```

Variables

- NODESREQUESTED
- NODESREQUESTEDPOLICY
- NUMOFCORES 1
- OUTPUTPATH
- QOS
- SHELL
- STARTINDEX
- USERPRIORITY

Custom Inputs

- INPUT 2
- OUTPUT 1
- VERSION 2

Moab Env Variables

- MOAB_ACCOUNT
- MOAB_BATCH
- MOAB_CLASS
- MOAB_DEPEND
- MOAB_GROUP
- MOAB_JOBID
- MOAB_JOBNAME

Published Unpublished

IMPORT EXPORT Cancel DONE EDITING

Benefits

- Application templates let an administrator create application templates for non-technical users.
- Non-technical users have a simple way to submit jobs for specific applications.

Agenda

- DataWarp
- Intel MIC “KNL”
- Viewpoint Web Portal (non-technical users)
 - User Portal
 - Administrator Portal
 - Remote Visualization (graphical interfaces)
 - Nitro HTC

Use Cases

- Users need to visualize their data to gain insights from it.
- Desktops or workstations with decent visualization hardware can be expensive.
- Data can be too large to move to another location.
- Non-technical users need a way to easily set up a remote visualization session.

Choose Remote Visualization Templates

The screenshot displays a web application interface with a navigation bar at the top containing 'HOME', 'WORKLOAD', 'TEMPLATES', 'FILE MANAGER', and 'SESSIONS'. The 'WORKLOAD' section is active, showing a table of job entries. A modal dialog titled 'Select Application Template' is open, allowing users to choose a template type. The dialog includes a search bar, a list of template types, and a 'Close' button.

Workload Table:

Job ID	Job Name	Submitter
Moab.114	ansys	hpotte
Moab.113	paraview	hpotte
Moab.112	ansys	hpotte
Moab.111	opendtect	hpotte
Moab.110	paraview	hpotte
Moab.109	Nitro_job	hpotte
Moab.108	Nitro_job	hpotte
Moab.107	paraview	hpotte
Moab.106	desktop	hpotte
Moab.105	ansys	hpotte

Select Application Template Dialog:

- Template Type: All
- ANSYS (2016/4/19, moab-admin)
 - All
 - HPC Application
 - Job Array
 - Remote Visualization**
 - Nitro Application
- Docker App (2016/3/2, moab-admin)
- Desktop (2016/3/15, moab-admin)
- Nitro Application (2016/4/8, moab-admin)

At the bottom of the dialog, there is a 'Show 10' dropdown and a pagination control with '1' and '2' buttons.

Choose Remote Desktop App Template

HOME WORKLOAD TEMPLATES FILE MANAGER SESSIONS

Search

Workload

Job ID	Job Name	Submitter	Start Time	End Time	Status	Nodes	CPUs	Time
Moab.114	ansys	hpotte	2016-04-12 12:12:51	2016-04-12 12:12:44	COMPLETED	1	1	00:12:00:00
Moab.113	paraview	hpotte						
Moab.112	ansys	hpotte						
Moab.111	opendtect	hpotte						
Moab.110	paraview	hpotte						
Moab.109	Nitro_job	hpotte						
Moab.108	Nitro_job	hpotte						
Moab.107	paraview	hpotte						
Moab.106	desktop	hpotte						
Moab.105	ansys	hpotte	2016-04-12 11:52:04	2016-04-12 11:51:57	COMPLETED	1	1	00:00:01:00

Show 10 entries

← prev 1 2 next →

Select Application Template

Template Type: Remote Visualization

- Desktop** (2016/3/15 moab-admin)
- Opendtect (Oil&Gas) (2016/3/15 moab-admin)
- Paraview (2016/3/15 moab-admin)
- Paraview w/ Desktop (2016/3/15 hpotter)
- Remote Viz Applicat... (2016/3/2 moab-admin)

Show 10

← « 1 » →

Close

Load Summary

JOBS IN A COMPLETED STATE

COMPLETED

11

View All Workload

Choose Graphical Desktop Type

Choose a remote desktop, either Gnome or KDE

Basic Settings

Basic Job Settings

Name

Time Management

Duration

Resources

Number of Cores

Total Cores

Desktop Settings

Desktop Interface

Gnome
KDE

Cancel

CREATE



Submit Remote Desktop Job

Choose a remote desktop, either Gnome or KDE

Job with ID "Moab.115" has been submitted

Basic Settings

Basic Job Settings

Name

desktop

Time Management

Duration

12:00:00

Resources

Number of Cores

Total Amount of Cores

Total Cores

1

Desktop Settings

Desktop Interface

Gnome

Cancel

CREATE



Remote Desktop Job's Compute Node

Data Management

Execution Path	/home/hpotter	...
Output Path	/home/hpotter	...
Error Path	/home/hpotter	...

Other Information

Partition Access List	None
Start Count	1

Resource Requirement Summary

Total Processors Requested	1
Total Memory Requested	1.0 GB
Total Swap Requested	N/A
Total Disk	N/A
Features	gpu

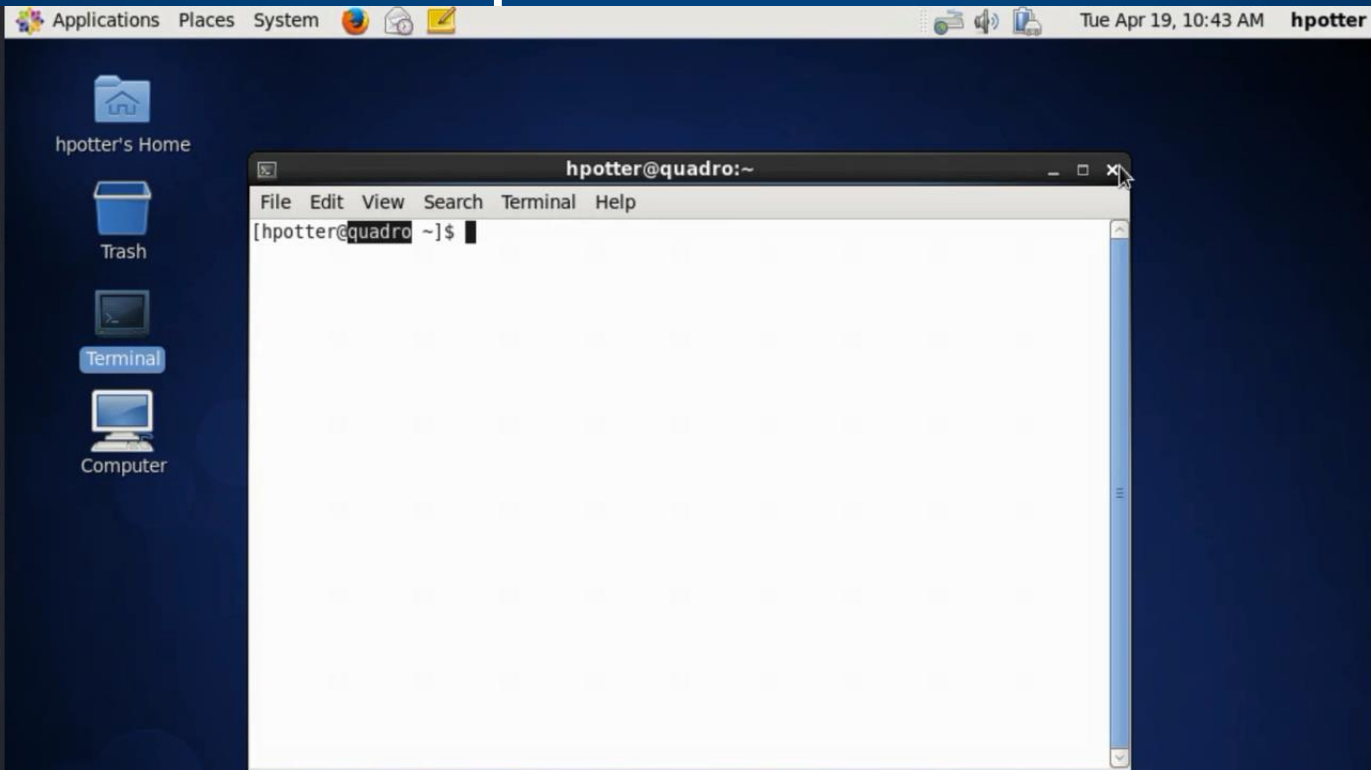
Total Nodes Requested	0
Allocated Node List	quadro
Allocated Node Count	1
Allocated Partition	demo
Operating System	N/A
Architecture	N/A
Total Generic Resources	N/A

➤ Requirement Details

Go Back



Remote Desktop Session Screen



Remote Visualization Session Controls



Resized Remote Viz Session Desktop

Tue Apr 19, 10:43 AM **hpotter**

Applications Places System



hpotter's Home



Trash



Terminal



Computer



Job Detail with Remote Viz Session

HOME WORKLOAD TEMPLATES FILE MANAGER SESSIONS

Job Details

Job Id: Moab.115 (desktop)


Submission Script: N/A


Reservation Name: N/A


Template: Desktop (v.6 CURRENT)

[Return to earlier search](#)

Status: **ACTIVE**
Job Status: **RUNNING**


Remote Viz Session 



 Job Messages



Credentials		
User	hpotter	Group hpotter
Account	engineeri...	
Class	batch	Quality of Service None

CPU Statistics

No utilization metrics found for this job 

Time Frame

10.2.184.78:8081/jobdetails/?job_name=Moab.115&job_id=Moab.115#



Canceling the Remote Desktop Session

Moab VIEWPOINT

Welcome, hpotter

HOME

WORKLOAD

TEMPLATES

FILE MANAGER

SESSIONS

Job status has been changed to "VACATED".

"cancel" Request was sent to server.

Job Details

Job Id : Moab.115 (desktop)

Submission Script: N/A

Reservation Name: N/A

Template: Desktop (v.6 CURRENT)

[Return to earlier search](#)

Status: **ACTIVE**

Job Status: **VACATED**

Remote Viz Session 



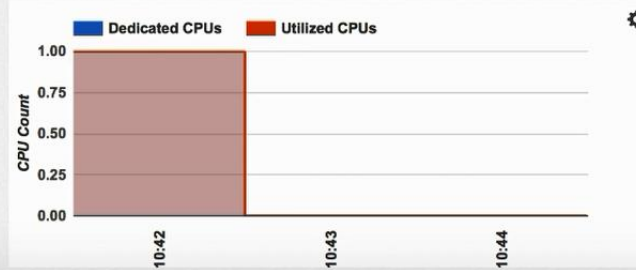
 

Job Messages

Credentials

User	hpotter	Group	hpotter	Account	engineeri...
Class	batch	Quality of Service	None		

CPU Statistics



Choose ParaView Application Template

HOME WORKLOAD TEMPLATES FILE MANAGER SESSIONS

Workload

Search: 16 results returned

Job ID	Job Name	Submit
Moab.115	desktop	hpotte
Moab.114	ansys	hpotte
Moab.113	paraview	hpotte
Moab.112	ansys	hpotte
Moab.111	opendtect	hpotte
Moab.110	paraview	hpotte
Moab.109	Nitro_job	hpotte
Moab.108	Nitro_job	hpotte
Moab.107	paraview	hpotte
Moab.106	desktop	hpotte
Moab.105	ansys	hpotte
Moab.104	ansys	hpotte
Moab.103	paraview	hpotte

Select Application Template

Template Type: Remote Visualization

- Desktop
2016/3/15
moab-admin
- Opendtect (Oil&Gas)
2016/3/15
moab-admin
- Paraview
2016/3/15
moab-admin
- Paraview w/ Desktop
2016/3/15
hpotter
- Remote Viz Applicat...
2016/3/2
moab-admin

Show 10

« 1 » →

Close

ParaView Input Data file selection

The image shows a web-based interface for creating a ParaView job. In the foreground, an "Open File" dialog box is open, displaying a file list from a remote file system. The selected file is "blood_cells.pvsm".

Open File Dialog:

- Path: Remote File System / home / hpotter / paraview
- Files:
 - blood_cells.pvsm (2016/03/15)
 - rectGrid.pvsm (2016/03/15)
- Show: 10 entries
- Buttons: Close, SELECT

Background Interface:

- Navigation: HOME, WORKLOAD
- Section: Create Job
- Section: Paraview
 - Basic Settings
 - Basic Job Settings
 - Name: para
 - Resources
 - Total Memory (GB): 4.00
 - Paraview Settings
 - Data File: [input field]

Cancel

CREATE

Submitting ParaView Remote Viz Job

Job with ID "Moab.116" has been submitted

HOME

WORKLOAD

TEMPLATES

FILE MANAGER

SESSIONS

Create Job

Paraview

Basic Settings

Basic Job Settings

Name

paraview

Time Management

Duration

12:00:00

Resources

Total Memory (GB)

4.00

Paraview Settings

Data File

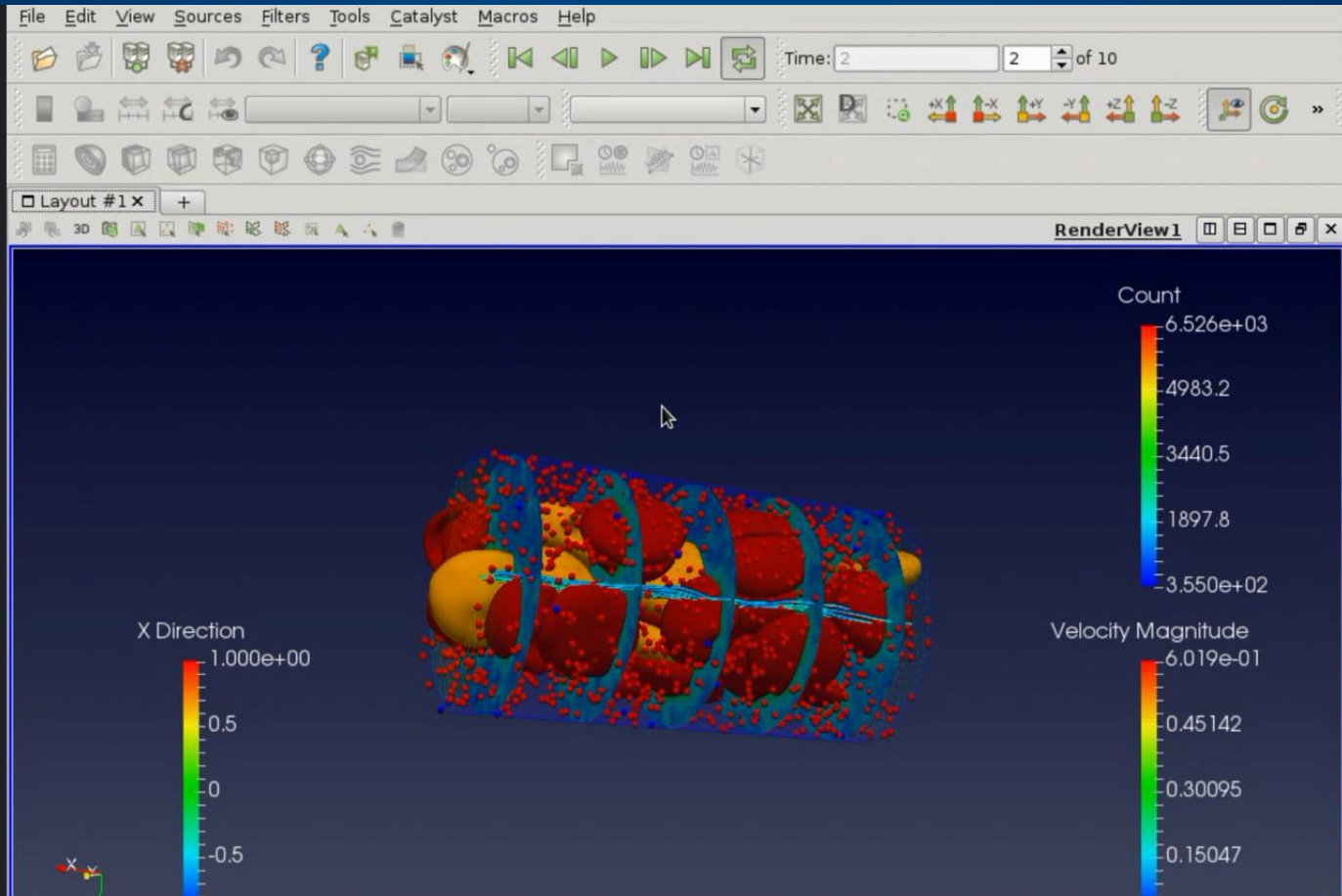
/home/hpotter/paraview/blood_cel

Browse...

Cancel

CREATE

ParaView Remote Viz Session



Adjusting Session Image Quality

The screenshot displays a software interface with a menu bar (File, Edit, View, Sources, Filters, Tools, Catalyst, Macros, Help) and a toolbar. The main window shows a 3D visualization of a cell structure with a color scale. The color scale ranges from blue (-3.550e+02) to red (6.526e+03). The visualization shows a central yellow sphere surrounded by red and blue structures. The interface also includes a 'RenderView1' window and a 'Settings' panel.

Time: 2 of 10

Layout #1 x

RenderView1

Count

6.526e+03

4983.2

3440.5

1897.8

-3.550e+02

Velocity Magnitude

6.019e-01

0.45142

0.30095

0.15047

Settings

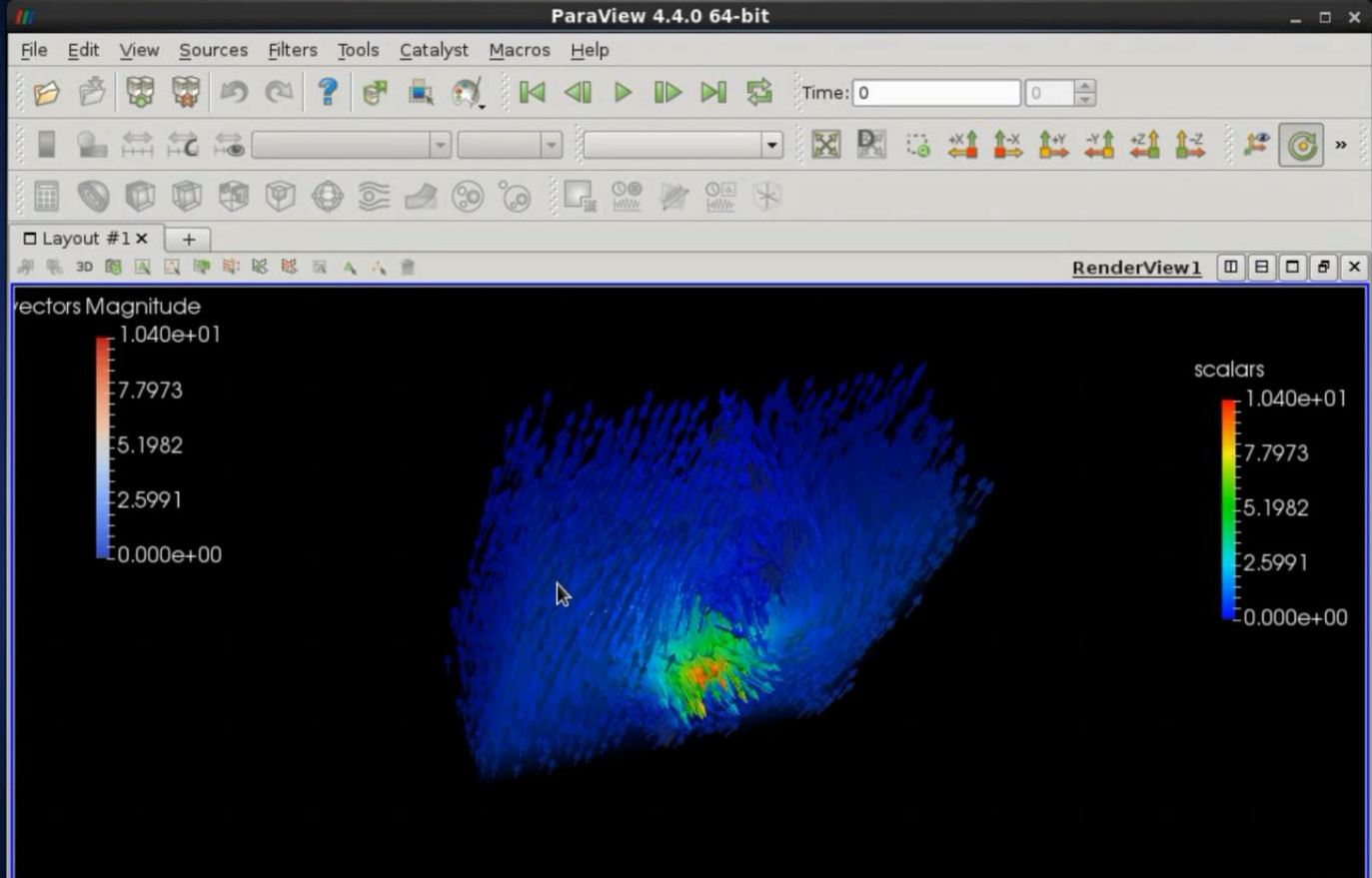
Image Quality **Low**

Frame Rate **30 fps**

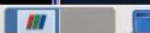
Frame Window **30 frames**

Remote Desktop / ParaView Session

Applications Places System Tue Apr 19, 10:47 AM hpotter



ParaView 4.4.0 64-bit



Benefits

- Technical and non-technical users can easily create remote visualization sessions with their applications and data.

Agenda

- DataWarp
- Intel MIC “KNL”
- Viewpoint Web Portal (non-technical users)
 - User Portal
 - Administrator Portal
 - Remote Visualization
 - **Nitro (HTC job scheduling)**

Use Cases

- A user can have thousands or millions of single-core to single-node jobs.
 - Parameter sweeps
 - Monte Carlo simulations
 - Regression tests
 - Other
- Large job queues
- Long scheduling cycles

Nitro HTC Scheduler Application

- Scheduler-agnostic HTC scheduler application
 - TORQUE
 - Slurm
 - Platform LSF
 - Cray ALPS
- Submitted as HPC job to scheduler

Nitro Job

- User converts HTC jobs to Nitro “tasks”
 - Tasks defined in Nitro Task file
- Submit 1 Nitro job with Task file
 - Schedule 1 parallel HPC job
 - Execute millions of HTC tasks

- What about HTC for non-technical users?

Choose Nitro Application Template

HOME

WORKLOAD

TEMPLATES

FILE MANAGER

SESSIONS

Search

Workload 

Job ID	Job Name	Submitter
Moab.117	paraview_desktop	hpotter
Moab.116	paraview	hpotter
Moab.115	desktop	hpotter
Moab.114	ansys	hpotter
Moab.113	paraview	hpotter
Moab.112	ansys	hpotter
Moab.111	opendtect	hpotter
Moab.110	paraview	hpotter
Moab.109	Nitro_job	hpotter

Select Application Template

Template Type

- All
- All
- HPC Application
- Job Array
- Remote Visualization
- Nitro Application**

 ANSYS

2016/4/19
moab-admin

 Docker App

2016/3/2
moab-admin

2016/3/3
moab-admin

 Desktop

2016/3/15
moab-admin

 Nitro Application

2016/4/8
moab-admin

Show 10

← « 1 2 » →

Close

Load Summary

JOBS IN A COMPLETED STATE

COMPLETED

14

View All Workload ▶

12:25:34 12:25:27

Nitro Task File selection

The screenshot shows a web browser window with a 'File Upload' dialog box open. The browser's address bar shows the URL `10.2.184.78:8081/create_job/?t=http://10.2.184.78:8081/...`. The dialog box is titled 'File Upload' and shows the current directory as 'templates'. The file list includes:

- ANSYS (1).template
- Calculator.template
- Desktop.template
- Job Array C...lator.template
- nitro.task.txt** (selected)
- Opendtect (...as).template
- Paraview.template
- script

The selected file 'nitro.task.txt' is shown in a preview pane with the following details:

- nitro.task.txt
- text - 900 KB
- Created Jan 12, 2016, 10:01 AM
- Modified Jan 12, 2016, 10:01 AM
- Last opened January 12, 2016 at 9:59 AM
- [Add Tags...](#)

The background web interface includes a sidebar with sections: 'RESOURCES' (Number of Cores, Total Nodes, Cores Per Node), 'Data Management' (Output Path), and 'Task File'. At the bottom of the page, there are 'Cancel' and 'CREATE' buttons.

Cancel

CREATE

Nitro Task file upload and job submission

Resources

Number of Cores

Nodes with Core Count

Total Memory (GB)

1.00

Total Nodes

1

Cores Per Node

8

Data Management

Output Path

/home/hpotter

File has been successfully uploaded. ✕

▼ Nitro Inputs

Task File

/home/hpotter/nitro.task.txt [Change](#)

Cancel

CREATE

Nitro job progress and statistics

▼ Nitro Statistics ⚙️

Progress

8%

State Running

Coordinator Host toi-901.vapor2.ac.localdomain

Task File /home/hpotter/nitro.task.txt

Task Log /home/hpotter/nitro/Moab.118/nitro_Moab.118.tasklog.txt

Job Log /home/hpotter/nitro/Moab.118/nitro_Moab.118.joblog.txt

Tasks

Pending	In Progress	Completed	Tasks / Sec
1,250	500	9,000 ▼	409.09

Total: 100,001

- Success: 9,000
- Failure: 0
- Timeout: 0
- Invalid: 0
- Insufficient: 0

Credentials

User hpotter Group hpotter Account engineeri...

Worker Summary

Workers	Task Threads	Avg Asgmt Duration	Avg Task Duration
1 ▼	2	1.097	0.003

CPU Statistics


Nitro applications track their own usage statistics. Please

Nitro job progress

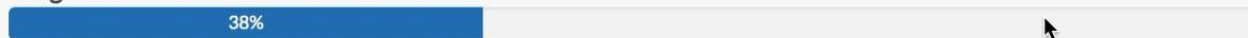
Reservation Name: N/A

Template: **Nitro Application (v.6 CURRENT)**

Job Messages

Nitro Statistics 

Progress



State Running

Coordinator Host toi-901.vapor2.ac.localdomain

Task File /home/hpotter/nitro.task.txt 

Task Log /home/hpotter/nitro/Moab.118/nitro_Moab.118.tasklog.txt 

Job Log /home/hpotter/nitro/Moab.118/nitro_Moab.118.joblog.txt 

Tasks

Pending	In Progress	Completed	Tasks / Sec
1,250	500	38,000 ▼	513.51
Total: 100,000			

Worker Summary

Workers	Task Threads	Avg Asgmt Duration	Avg Task Duration
1 ▼	2	0.915	0.002

Credentials

User hpotter

Group hpotter

Account engineeri...

CPU Statistics

Nitro applications track their own usage statistics. Please

Nitro Task Log file display during job

10.2.184.78:8081/file-manager/?path=/home/hpotter/nitro/Moab.118/nitro_Moab.118.tasklog.txt

File Manager


Remote File System / home / hpotter / nitro / Moab.118

Upload New Folder Name

.. / logs

[GO BACK](#)

nitro_Moab.118.tasklog.txt



JobID	TaskID	Line	Name	Status	ExitCode	Hostname
Moab.118	1	1	Success	0	toi-901.vapor2.ac.loc	
Moab.118	2	2	Success	0	toi-901.vapor2.ac.loc	
Moab.118	3	3	Success	0	toi-901.vapor2.ac.loc	
Moab.118	4	4	Success	0	toi-901.vapor2.ac.loc	
Moab.118	5	5	Success	0	toi-901.vapor2.ac.loc	

Size: 2.67 MB Modified: 2016/04/19

Download Compress Move Copy Rename Permissions Delete

Benefits

- Remove thousands-to-millions of HTC jobs from HPC scheduler queue(s)
- Execute HTC jobs faster
- Non-technical users can
 - Submit Nitro jobs
 - Monitor Nitro job progress
 - Examine Nitro Task results



Questions?

PMIx Support

- **Process Management Interface for eXascale**
 - Open-source Project on github
 - Intel, Mellanox, IBM, Adaptive Computing, SchedMD
- **Benefits**
 - “Instant On” very fast job start (10 minutes → 2 seconds)
 - Asynchronous, non-blocking operations
 - Blob-based data transfers
 - Fast broadcasts/collectives
 - Interfaces with RMs (e.g., TORQUE)
 - *Will work with malleable/evolving jobs in future*

Malleable and Evolving Jobs

- **Next-generation application/RTE support**
 - Malleable jobs (scheduler → application/RTE)
 - Evolvable jobs (application/RTE → scheduler)
 - Need standard API to negotiate resources
 - Like MPI for parallel communications
 - *Gathering use cases for PMIx API definition*
- **Benefits**
 - Standard application API for scheduler/app dialog
 - Scheduler and Malleable/Evolving Application Dialog (SMEAD) API definition
 - Allows applications to ask for and return resources
 - Allows scheduler to give and take resources to and from a job

Backup Slides