iRODS
Open OnDemand
Eureka

Omnibond
a customer-focused software engineering and support company
Leadership Team

- Over 40 years combined experience in facilitating and supporting academic and corporate research in using the tools and technologies of advanced computing
- Experience at the working and technical, project and executive management levels at Clemson, Purdue and Miami Universities and the National Center for Supercomputing Applications located at UIUC
- Expertise in software development, systems integration, operations, applications support, data transmission, identity and access management, customer relations and research facilitation and engagement
- Over three decades of funded projects from NSF, DoD, DoE, NSA, NIST and DARPA
- Presidential Fellow & CSTAAC Committee Members

Omnibond
a customer-focused software engineering and support company
● **Identity & Security Management**
  ○ NetIQ Identity Manager Connectors
  ○ Thousands of customers, sold through Novell/Micro Focus/OpenText, since early 2000’s
  ○ OmniPasskey Passwordless MFA Shibboleth Plug-in

● **Computer Vision & AI**
  ○ TrafficVision - AI based Automated Incident Detection (AID) & Data from existing cameras on roadways
  ○ BayTracker - Retail Vehicle Tracking and Timing
  ○ Port Observer - Drayage Queuing, AIS, Dashboard for Ports

● **Cloud HPC and Storage Orchestration**
  ○ CloudyCluster
  ○ OrangeFS
  ○ Eureka Project
  ○ Custom Cloud <-> On-Prem Integration
I have worked with Omnibond development and support for almost 15 years. They always deliver the highest level of support possible. I have been in Technical Support for 23 years and have worked with different companies across the world. Omnibond is at the top in response time and for going the extra mile to help our customers. I have no reservation in recommending them as a great company.

Reed Harrison
Provo, UT
Support Engineer
Novell/NetIQ/MicroFocus/Opentext
Real-time HPC & AI

Kevin Kissell, Technical Director, Office of the CTO

Customers

Features

- Incident Detection
  - Stopped Vehicle
  - Slowed Traffic
  - Debris in Roadway
  - Low Visibility
  - Pedestrians
  - Wrong-Way Drivers*

- Real-Time Data Collection
  - Speeds Per Lane / Per Direction
  - Vehicle Counts Per Lane / Direction
  - Lane Occupancy and Density
  - Congestion Index
  - Classification:
    ** Motorcycle / Car / Truck / Large Truck

Alerts, Incident Images & Clips

Data CSV export & JSON API
Scaling on AWS

AWS News Blog

Natural Language Processing at Clemson University – 1.1 Million vCPUs & EC2 Spot Instances

Google HPC Blog Post
Cloud against the storm: Clemson’s 2.1 million VCPU experiment
https://cloud.google.com/blog/topics/hpc/clemson-experiment-uses-2-1-million-vcpus-on-google-cloud

Kevin Kissell, Technical Director,
Office of the CTO

Urgent HPC can Burst Affordably to the Cloud
https://www.nextplatform.com/2020/01/08/urgent-hpc-can-burst-affordably-to-the-cloud/

- 133,573 GCP Instances at peak
- 2,138,000 vCPUs at peak
- 6,022,964 vCPU hours

Processed 2,479,396 hours (~256TB) of video data

- ~4 hours of runtime
- ~1M vCPU within an hour
- ~1.5M vCPU within 1.5 hours
- 2.13M vCPU within 3 hours

Total Cost: $52,598.64 USD
Average cost of $0.008 USD per vCPU hour
Create a familiar, secure & fully operational computational cluster in minutes, complete with:

**Encrypted Storage:** EBS, OrangeFS on PD

**Compute:** Job Driven Elastic Compute through CCQ (Spot, On-Demand, GPU)

**Schedulers:** Torque & SLURM with the CCQ Meta-Scheduler
  - Supports Billing Tags per job/user
  - Placement Policies, Advanced Networking
  - Supports Multiple Custom Images

**End User Friendly UI:** Open OnDemand

**Includes Familiar Software**

**HPC Libraries:** Boost, Cuda Toolkit, Docker, FFTW, FLTK, GCC, Gengetopt, GRIB2, GSL, HDFS, Intel MPI, Intel Runtimes, ImageMagick, JasPer, mpich, NetCDF, NumPy, Octave, OpenCV, OpenMPI, PROJ, R, Rmpi, SciPy, SWIG, WGRIB, UDUNITS, .NET Core, Singularity, Queue, Picard, xrootd, etc…

**HPC Software:** Ambertools, ANN, ATLAS, BLAS, Blast, Blender, Burrows-Wheeler Aligner, CESM, GROMACS, JupyterLab, LAMMPS, NCAR, NCL, NCO, nwchem, OpenFoam, papi, paraview, Quantum Espresso, SAMtools, WRF, Galaxy, Vtk, Su2, Dakota, Gatk, etc…

**ML Software:** Mlpack, NuPIC, Octave, OpenCV, PICARD, Queue, Scikit-learn, Tensorflow

**Sample Jobs:** Intel Cluster Checker, Mpi_prime, wrf, etc…
Create a familiar, secure & fully operational computational cluster in minutes, complete with:

**Encrypted Storage:** GCS, OrangeFS on PD

**Compute:** Job Driven Elastic Compute through CCQ (Preemptable, On-Demand, GPU)

**Schedulers:** Torque & SLURM with the CCQ Meta-Scheduler
  - Supports Billing Labels per job/user
  - Placement Groups, BulkAPI, Tier1 Networking
  - Supports Multiple Custom Images

**End User Friendly UI:** Open OnDemand

**Includes Familiar Software**

**HPC Libraries:** Boost, Cuda Toolkit, Docker, FFTW, FLTK, GCC, Gengetopt, GRIB2, GSL, HDF5, Intel MPI, Intel Runtimes, ImageMagick, JasPer, mpich, NetCDF, NumPy, Octave, OpenCV, OpenMPI, PROJ, R, Rmpi, SciPy, SWIG, WGRIB, UDUNITS, .NET Core, Singularity, Queue, Picard, xrootd, etc...

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**Job Script Directives Dictate elastic node type through CCQ (preemptible, GPU, or Standard)**
Integration of OOD into CloudyCluster

- As part of the Cloudify Gateways program (Omnibond, OSC, U Buffalo, Va Tech)
- Full deployment automated as part of the CloudyCluster launch
- The Collaboration Continues

"Your browser is the supercomputer: On Demand is a no-tears shortcut to research-computing" from Matt Windsor of University of Alabama at Birmingham. A key phrase: “No experience necessary”
Relion & CRYO-EM

Working with the Cianfrocco Lab at University of Michigan to test data transfer and scalability to the Cloud for CRYO-EM projects using RELION

Also working with related Startups in the space that don’t have access to large on prem clusters.

Initially introduced as part of the Cloudify Program through the SGCI.

Cianfrocco is willing to consult with customers in conjunction with Omnibond and CloudyCluster

Another CRYO-EM project is in progress with the ERN
To expand the collaboration’s computation capabilities, Walter Landry wanted to see how SDPB would scale on Google Cloud. Working with Omnibond’s CloudyCluster and leveraging the HPC VM image, Landry achieved comparable performance and scaling to an on-premises cluster at Yale, based on Intel Xeon Gold 6240 processors and Infiniband FDR.
Projects Using Tapis

- A2CPS
- Bridging Barriers
- CyVerse
- DesignSafe
- Drug Discovery Portal
- ECCO
- Ike 'Wai (at the University of Hawaii Manoa)
- iReceptor
- iR+ 
- NeuroNex 3DEM
- Planet Texas 2050
- Science Gateways Community Institute
- Synergistic Discovery and Design Environment (SD2E)
- VDJServer
- UTRC

https://github.com/omnibond/automaton
The Meta-Scheduler Approach

Scheduler Independent

- Torque
- Slurm

Allow for Meta-Scheduler Directives

- Instance Type, each job can have a different instance type and billing model.
- GPU
- Spot, Preemptible
- Billing Tags/Labels
- Volume Type
- Custom Images for Different Jobs

Turns “Scheduler” into Dispatcher Handling:

- Instance and appropriate subnet provisioning
- Instance deletion
Project

Eureka

see the [show](#)
OOD UI + Eureka Vision

- Interactive
  - Applications & Launchers
  - API Applets & Saas Apps
  - Project Focused

- Compute
  - Compute Anywhere (HPC, AI, & Beyond)
  - Enable Cloud Specialties
  - Simplify Compute and Storage Interactions

- Storage
  - Integrate Diverse Storage Resources
  - Collaborate First
  - Project Level Data Lifecycle
Technology

- **Cloud Jump UI & Open OnDemand**
  - HPC Industry Standard
  - OODUI - Simplify & Empower
- **Omni-Scheduler**
  - Coordinates UI, Storage, & Compute
- **Constellation Driven Terraform**
  - Multi-Cloud Enabler
- **iRODS**
  - Metadata Driven Data Management & Movement
  - Designed for Diverse Storage
Inside-Out

Open OnDemand UI
User Experience First
Design & Usability
Forward

Project Leads UI
Leads Projects View
Whats Running
Utilization Tools

Admin UI
Global View of Projects &
Users
What’s Running Globally
Global Utilization
Open OnDemand Example Deployments

Don’t see an organization?
The more the merrier!
Let us know any that belong on the list

openondemand.org/orgs
Eureka - Architecture (Work in Progress) 5/2023

Cloud Jump UI (Passenger app)  Open OnDemand Apps

Open OnDemand

OmniSched

Constellation

Constellation TF Generation  Constellation App Management

TerraForm

AWS  GCP  Azure  Docker
K8s  Spark  Instances Linux & Win  kvm

Compute
MPI, Container, serverless, gpu, arm, x64,

iRODS
Data
Stage/Transfer (object, orangefs, iRods)

Globus

Interactive & Dist Research App(s)
Expand meta-scheduler concept (OmniSched) to handle:

- Cross Cloud - leveraging Constellation / TerraForm
  - Enable On-Prem (TF -> kvm)
- Job routing between locations
- Dynamic Scratch
  - Driven by job Directives
- Data Staging
  - Driven by Job Directives (Input Data & Results)
- Beyond HPC
  - Data Science Apps
  - HPC adjacent (publishing, websites, etc..)
  - Enable Apache Spark
  - K8s
  - Etc…
- Scheduling Data Movements
  - iRODS integration
The Integrated Data Management

In addition to Job based directives

Data Management Capabilities

- Replicate
- Archive
- Ingest
- Tier
- Publish

All configured in OOD with iRODS
Deployment Architecture

AWS Cloud

Availability Zone

NAT Gateway

Public subnet

OmniSched
AFW
Constellation

Login Node
OnDemand
New UI

Private subnet

Session Instances

IRODS
Globus

EFS

Proj 1
Proj 2 etc...

Private subnet

Session Instances

S3

EFS

S3
Demo

EUREKA

see the show
Cloud Jump

Data Science Platform

### Advanced Discovery
- **Collaborators**: 1
- **Running**: 2
- **Cores**: 0
- **GPUs**: 0
- **Sessions**: 1
  - VS Code: 2
  - Desktop: 0
  - VS Code: 0
  - RStudio: 0
- **State**: Running
- **Time**: 0h 18m

### Data Science
- **Collaborators**: 0
- **Running**: 0
- **Cores**: 0
- **GPUs**: 0
- **Sessions**: 0
  - VS Code: 0
  - Desktop: 0
  - VS Code: 0
  - RStudio: 0
- **State**: Running
- **Time**: 0h 11m

### NewProj
- **Collaborators**: 0
- **Running**: 0
- **Cores**: 0
- **GPUs**: 0
- **Sessions**: 0
  - VS Code: 0
  - Desktop: 0
  - VS Code: 0
  - RStudio: 0
- **State**: Running
- **Time**: 0h 8m
Project Eureka - Project Based UI

Data Science Platform

Advanced Discovery

Launchers ▼ Add Launcher ▼ Show Fewer

Desktop

4 cores
Launch

VS Code

4 cores
Launch

RStudio

4 cores
Launch

Jupyter

4 cores
Launch

Spyder

4 cores
Launch

Spyder2

4 cores
Launch

Active Sessions ▼

- Burstable On
  - VS Code
    - Job ID: 14

- Burstable On
  - Jupyter
    - Job ID: 15

Cores
RAM
GPU
End
Connect

Cores
RAM
GPU
End
## Future Storage Collections

<table>
<thead>
<tr>
<th>Name</th>
<th>Resource Path</th>
<th>External Path</th>
<th>Storage Type</th>
<th>Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProjectDirName</td>
<td>projects/projectDirName/</td>
<td>pvfs2://hbs-ofs-1:3334:/shared/projects/ProjectDirName</td>
<td>Posix</td>
<td>None</td>
</tr>
<tr>
<td>Bucketname</td>
<td>projects/Bucketname/</td>
<td>s3://Bucketname.s3.amazonaws.com/</td>
<td>Object</td>
<td>Replicated</td>
</tr>
</tbody>
</table>

**Add Storage Resource**
Future Collections Access in Storage Manager

Additional Storage Collections
- **iCommands**
  - Initialization (default collections, groups, permissions, and metadata)
- **REST Client**
  - Initialization:
    - Create corresponding iRODS user for each LDAP user
  - Frontend file manager:
    - List files/collections
    - Create collections/files
    - Rename files
    - Upload/download files (stream data)
- **NFSRODS**
  - Allow apps (e.g., VS Code Server) to directly access iRODS files
- **iRODS Rule Language (NREP)**
  - Automatically tag collections with custom metadata
- **Next**
  - OrangeFS MD Syncer (dynamic scratch and linux home sync to iRODS)
    - TBD: How to notify the catalog of file adds, deletes, updates
Tentative Timeline

July

- Storage Manager - Download, Hidden Files, Multi-Select, create menu at top
- Instances - Start Stop vcpu/ram display in list
- Project - directory prefill,
- Add Launcher - option in left menu
- iRODS - s3 bucket create

Aug

- iRODS - rules, groups, vault resync
- Storage Mgr - Unzip / Zip and Download drag n drop upload, show Linux homedir
- Middleware - LDAP/iRODS/AFW sync
- OmniSched - Permissions, enhanced connectivity

Sep

- Jobs - per job scratch, data staging, billing tags
- Launcher - file search
- AdminUI - Initial Admin UI
- iRODS - OranegFS Syncer
- Platform - local Docker Compute Nodes

Oct

- AWS - FCS
- Platform - GCP
- Platform - KVM
- Jobs - Job Routing
- UI - Job Builder
Services

● Remote Tier 1.5 support
  ○ Hand off from HBS to Omnibond to help with:
    ■ Platform Development
    ■ Application Integration
    ■ Applet AI Development
    ■ Researcher 1 on 1 Support

● Project Management
  ○ Omnibond can optionally provide a portion of a project manager to coordinate the overall project

● R&D
  ○ Cutting Edge Research & Development for future features
Questions?

boyd@omnibond.com

see the show