Omnibond
Background
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 Member

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

● 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
OmniPasskey - MFA Passwordless Shib Plugin

Enables Shibboleth to support the built in passkey standard on Apple, Google, and Microsoft Devices

We are looking for early access participants
CloudyCluster
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, 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...

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

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
  - Spot, Preemptible
- GPU
- Billing Tags/Labels
- Volume Type
- Custom Images for Different Jobs

Turns “Scheduler” into Dispatcher Handling:

- Instance and appropriate subnet provisioning
- Instance deletion
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**

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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
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
- Working on project based UI initially to support data scientist project teams.
- 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"
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.

Figure 5 Final aldolase reconstruction at 2.8 Å resolution. (a) Sharpened aldolase reconstruction at 2.8 Å resolution. (b) Example densities and models for aldolase at 2.8 and 4.9 Å resolution. (c) FSC curve for the final reconstruction.
TAPIS - PEARC ‘22 Poster, Gateways ‘22 Paper

Projects Using Tapis

- A2CPS
- Bridging Barriers
- CyVerse
- DesignSafe
- Drug Discovery Portal
- ECCO
- Re ‘Wat (at the University of Hawaii Manoa)
- iReceptor
- i+T
- NeuroNex 3DEM
- Planet Texas 2050
- Science Gateways Community Institute
- Synergistic Discovery and Design Environment (SDD2E)
- VDJServe
- UTRC

Extending Tapis Workflow Management Framework with Elastic Google Cloud Distributed System using CloudyCluster by Omnibond

ERIC LAM, University of Hawaii, Manoa, USA
SEAN CLEVELAND, University of Hawaii - Information Technology Services - Cyberinfrastructure, USA
COLE MCKNIGHT, Omnibond Systems, USA
BOYD WILSON, Omnibond Systems, USA
RICHARD CARDONE, Texas Advanced Computing Center, USA
JOE STUBBS, Texas Advanced Computing Center, USA

https://github.com/omnibond/automaton
Rutgers & Cloud-Enabled Research

- 8,000+ faculty, 300 research centers
- Part of team’s mission is pairing researchers with the right tools for their projects
- All faculty, staff, students have free access to our central HPC resources, but there are constraints
- Central IT manages accounting for granted and discounted cloud credits, including STRIDES-provided resources
- Cloud marketplaces are a key differentiator when considering cloud vs. on-prem capabilities
- CloudyCluster is the primary recommendation for compute elasticity and scale
Testing turboWave Modeling Scaling in CloudyCluster for NRL Briefing on Cloud Capabilities.
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.
Project Eureka
Overview
Project Eureka Vision

- Interactive Apps
  - Applications & Launchers
  - API Applets & Saas Apps
  - Project Focused
- Computational Apps
  - Compute Anywhere (HPC, AI, & Beyond)
  - Enable Cloud Specialties
  - Simplify Compute and Storage Interactions
- Storage Integration
  - Integrate Diverse Storage Resources
  - Collaborate First
  - Project Level Data Lifecycle
The Omni-Scheduler Approach

Expand meta-scheduler concept (OmniSched) to handle:

- Dynamic Scratch
  - Driven by job Directives

- Data Staging
  - Driven by Job Directives (Input Data & Results)

- Beyond HPC
  - Data Science & Engineering Apps
  - HPC adjacent (publishing, websites, etc.)
  - Generative AI
  - Enable Apache Spark
  - K8s

- Scheduling Data Movements
  - iRODS integration

- Cross Cloud - leveraging Constellation / TerraForm
  - Enable On-Prem (TF -> kvm)

- Job routing between locations
The Integrated Data Management

In addition to job based directives

Data Management Capabilities

- Replicate
- Archive
- Ingest
- Tier
- Publish

All configured in Eureka/OOD with iRODS
The Integrated Budget Management

Budget Management

- Person
- Project
- Department
- Limits with Actions
- Tag Integration with Cloud Providers Billing
Multi-Cloud Architecture

Job Routing

OmniSched
Technology

- **Project UI with Open OnDemand**
  - HPC Industry Standard
  - Project-UI - Simplify & Empower

- **iRODS**
  - Metadata Driven Data Management & Movement
  - Designed for Diverse Storage

- **Constellation Driven Terraform**
  - Vendor Supported Interfaces
  - Multi-Cloud Enabler

- **Omni-Scheduler**
  - Coordinates UI, Storage, & Compute
Overarching Architecture

Project Based UI
- Project-UI
- OPEN OnDemand

Interactive and HPC Apps
- Jupyter
- Spyder
- OpenFOAM

Integrated Storage
- iRODS

Cloud Integration
- TERRASPACE
- Terraform

AFW.tools
- Constellation

Integrated Storage
- AWS
- Google Cloud
- Microsoft Azure
- KVM

Interactive and HPC Apps
Open OnDemand Deployments

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

openon-demand.org/orgs
iRODS

**Storage Tiering**
Efficient Policy-Driven Storage Utilization

**Open Source Data Management Software**
- Automated Ingest
- Storage Tiering
- Compliance
- Auditing
- Indexing
- Provenance
- Integrity

**Synchronization**
Open Source Policy-Driven Data Replication

**Data to Compute**
Open Source Metadata-Driven HPC Workflow

**From Ingest to Institutional Repository**

**DATA LIFECYCLE**
- Data: Private, Stored, Analyzed, Published, Preserved, Ingested
- State: Private, Shared, Published, Preserved, Ingested
- Policy: Access, Distribution, Ownership, Access, Ownership

As data matures and reaches a broader community, data management policy must also evolve to meet these additional requirements.
Cloud Image Customization
for seamless operation
- For a majority of workloads the cloud image can look like on premise image

Integrating Cloud <-> On-Prem
- Providing the ability to make the cloud simplified to the end researcher.

Job Cloud Billing Integration
- From an auditing or bill back perspective

IDM Integration
on Premise and Cloud HPC including HPC System Consolidation

Data & Results Integration

Training & Tools
to train the Research Computing Support Staff
Deployment Architecture (AWS Example)

AWS Cloud

VPC

Public subnet

Login Node

Project-UI

Auth Options
Local LDAP,
OIDC to SAML or
AD/AzureAD (Entra)

OmniSched

AFW Constellation

Private subnet

Session Instances

Session Instances

Private subnet

IRODS

Globus

S3

EFS

Proj 1
Proj 2 etc…

Availability Zone

NAT Gateway
Identity Architecture (Using AWS as an Example)
User-Level Security Architecture

Server Frontend
(runs as Apache User)

Functions
User Authentication
Reverse Proxy

HTTPS/WSS

Per User NGiNX
(Runs as each individual user)

Eureka-UI

HTTPS/WSS

IPC Sockets

Function

Apache

HTTP/WS

Interactive and HPC Apps

jupyter
R Studio
spyder
OpenFOAM

File actions run as the user
Jobs run as the user
Data actions run as the user
Project Eureka
Demo/Screenshots
Advanced Discovery

- **Desktop**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **VS Code**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **RStudio**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **Jupyter**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **Spyder**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **Stata**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **Spyder2**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **OpenFOAM Small**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

- **OpenFOAM Large**
  - 2 cores
  - 4 RAM
  - GPU
  - Launch

**Active Sessions**

- **RStudio 2023.03.0**
  - Running
  - 2 cores
  - 4 RAM
  - GPU
  - End

- **Jupyter 4.0.0**
  - Running
  - 2 cores
  - 4 RAM
  - GPU
  - End

- **OpenFOAM Small**
  - Running
  - 2 cores
  - 4 RAM
  - GPU
  - End
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<th>Name</th>
<th>Target</th>
<th>Resource Path</th>
<th>External Path</th>
<th>Storage Type</th>
<th>Automation</th>
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<td>None</td>
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<td></td>
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<td>projects/KickBucket/</td>
<td>s3://storage.googleapis.com/bucket/KickBucket</td>
<td>Object</td>
<td>Tiered</td>
</tr>
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Add Storage Resource
Future Collections Access in Storage Manager

Data Science Platform

Discover Innovation

prj-storage > Folder1

<table>
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<th>last_write_time</th>
<th>size</th>
<th>type</th>
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<td>3821822</td>
<td>data_object</td>
<td>prj-storage/Folder1/OmniPasskey.png</td>
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<td>Screenshot 2023-05-14 at 7.31.42 PM.png</td>
<td>1684165200</td>
<td>205944</td>
<td>data_object</td>
<td>prj-storage/Folder1/Screenshot 2023-05-14 at 7:31:42 PM.png</td>
</tr>
</tbody>
</table>

S3 Bucket-1

GCS Bkt

Additional Storage Collections