Accelerate Insights
Converging Cloud and HPC

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Adaptive Computing Highlights

- Innovating world-class HPC, Big Data, and Cloud solutions
- Over a decade of experience
- Pioneering in Scheduling and Optimization
- 70+ patents issued or pending
- Backed by top-tier investors
- Numerous customers in the Top 500 and Fortune 500
  - Top systems including: Blue Waters, Titan, Cielo, Hopper
  - Major multi-nationals including: DOW, ExxonMobil, & Boeing
  - Largest provider of HPC workload management software to HPC sites*
  - Global partnerships include Intel, Cray, HP, IBM, SGI, & Microsoft
Accelerating Insights with Big Workflow

- **Unify data center resources**
  - As a single, adaptive ecosystem
  - Technical computing (HPC & big data)
  - Public and private cloud
  - Bare metal and virtual machines

- **Optimize the analysis process**
  - Increase throughput and productivity
  - Ensure SLAs, maximize uptime
  - Reduce cost, complexity and errors

- **Guarantee service to the business**
  - Policies that model your organization
  - Prove services were delivered
  - Job completion in spite of failures
  - Verify resources were allocated fairly
HPC Bursting
Virtual Cluster and Job Isolation Use Case

- **Medical research**
  - Health information privacy regulations

- **Hospital Isolation**
  - One physical data center shared among multiple hospitals
  - Hospitals have minimum compute node requirement
  - Dynamically partition data center into independent “virtual clusters”

- **Patient Isolation**
  - One patient – one job
  - Isolate patient job from all other patient jobs
  - Run 1 patient job in 1 VM on 1 compute node for complete isolation
Virtual Cluster and Job Isolation Use Case

- **One physical HPC cluster**
  - Multiple “virtual clusters”
  - Virtual clusters completely isolated using own scheduler
  - One partition of “unused” compute nodes for on-demand allocation to “virtual clusters”

- **Virtual clusters expand and shrink resources**
  - Request compute nodes from “unused” partition
  - Provision, use, and destroy one VM per compute node
  - Return compute nodes to “unused” partition
  - Triggered by job backlog “pressure”

- **HPC Bursting**
Canadian Hospital Consortium

Pilot project with two hospitals and one consortium cluster with three partitions

Two partitions for two hospitals (A & B) and one “free” partition (HPC)
Users submit jobs to B Moab until job backlog present
Hospital Consortium

Job backlog triggers B Moab to request additional resources of HPC Moab.
Hospital Consortium

HPC Moab allocates unused nodes and informs B’s Moab of resources
Hospital Consortium

B Moab adds allocated nodes to its cluster
Hospital Consortium

B Moab runs jobs on new additional nodes
Hospital Consortium

When job backlog eases, B Moab returns nodes to HPC Moab
Users submit more jobs to B Moab, repeating cycle
Virtual Cluster and Job Isolation Use Case

- Use case can extend to cloud resources
- Future possible use of OpenStack for PM and VM provisioning
High-Throughput Computing (HTC)
Nitro Task Manager

- **Distributed Scheduling Approach**
  - Combines small, homogeneous jobs into a “batch of tasks”
  - Creates policies for entire batch

- **Schedules batch as one job**
  - Incurs scheduling overhead only once

- **Launches Nitro job with task file**
  - Nitro “coordinator” launches tasks on “workers”
  - Tasks execute on Nitro job’s allocated resources

- **Independent Product**
  - Submit as job to any batch scheduler
  - Run standalone
Nitro Task Manager

- **100x faster throughput for small, short, serial jobs**
- **Early-access Version Benchmark**
  - 13,500 tasks/second submission rate
  - Sustained in 20-node EC2 cluster
  - 10 million tasks <12.5 minutes
  - Ramps higher for larger systems