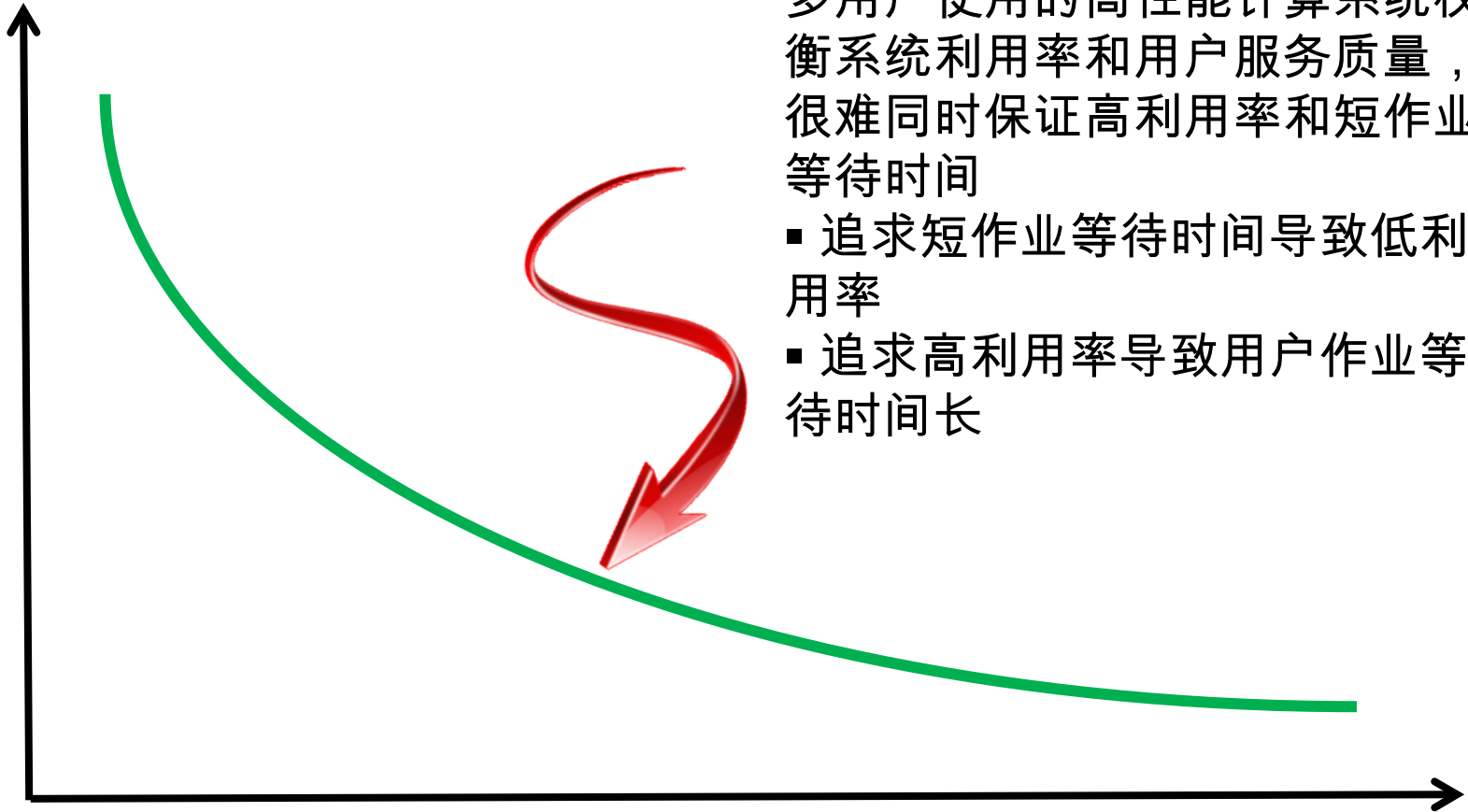


# 高性能计算在云计算中的应用

William Lu 陆伟钊, Ph.D.

# 高性能计算系统管理的挑战

利用率/吞吐量



多用户使用的高性能计算系统权衡系统利用率和用户服务质量，很难同时保证高利用率和短作业等待时间

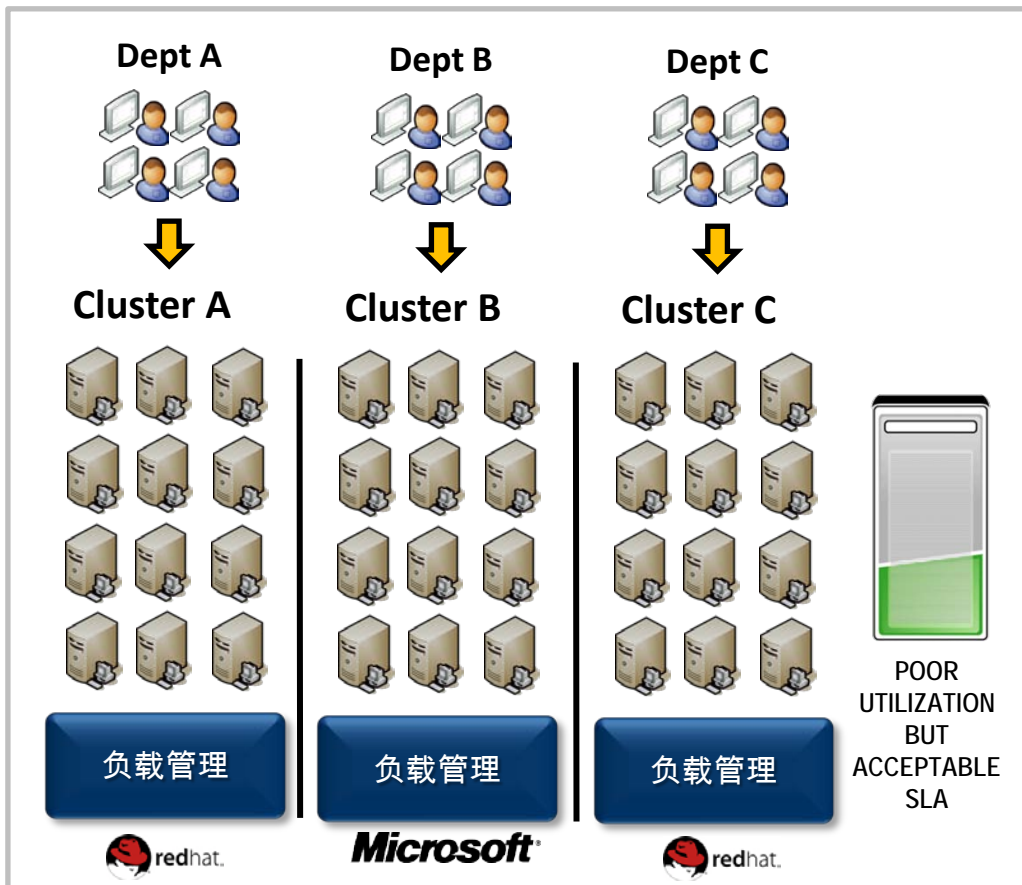
- 追求短作业等待时间导致低利用率
- 追求高利用率导致用户作业等待时间长

资源保证/短作业等待时间

# 独立应用机群

保证资源和服务质量

独立应用机群-“Cluster Sprawl”



用户要求和经费管理导致独立的机群布署

## ✓ 优点

- 用户满意
- 用户和应用间隔离性好

## ✗ 缺点

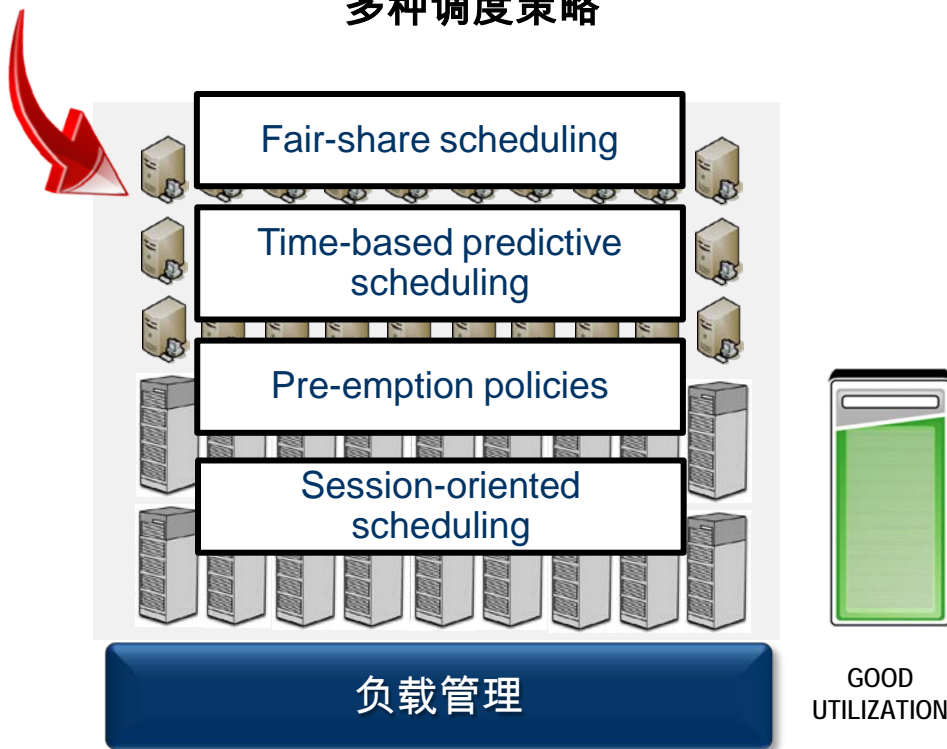
- 系统利用率低
- 管理成本高
- 不能满足高峰需求

An adequate quality of service is achieved, but with high infrastructure cost

## 优化利用率和成本

共享系统支持多种应用

### 多种调度策略



最先进资源和负载管理软件能大大提高系统利用率和降低系统成本

### ✓ 优点

- 高吞吐量
- 较低运行成本
- 较高系统利用率

### ✗ 缺点

- 不能动态改变应用运行环境
- 运行能力有上限，不能满足高峰需求

# 云计算

## 云计算设立了用户服务水准的新标准

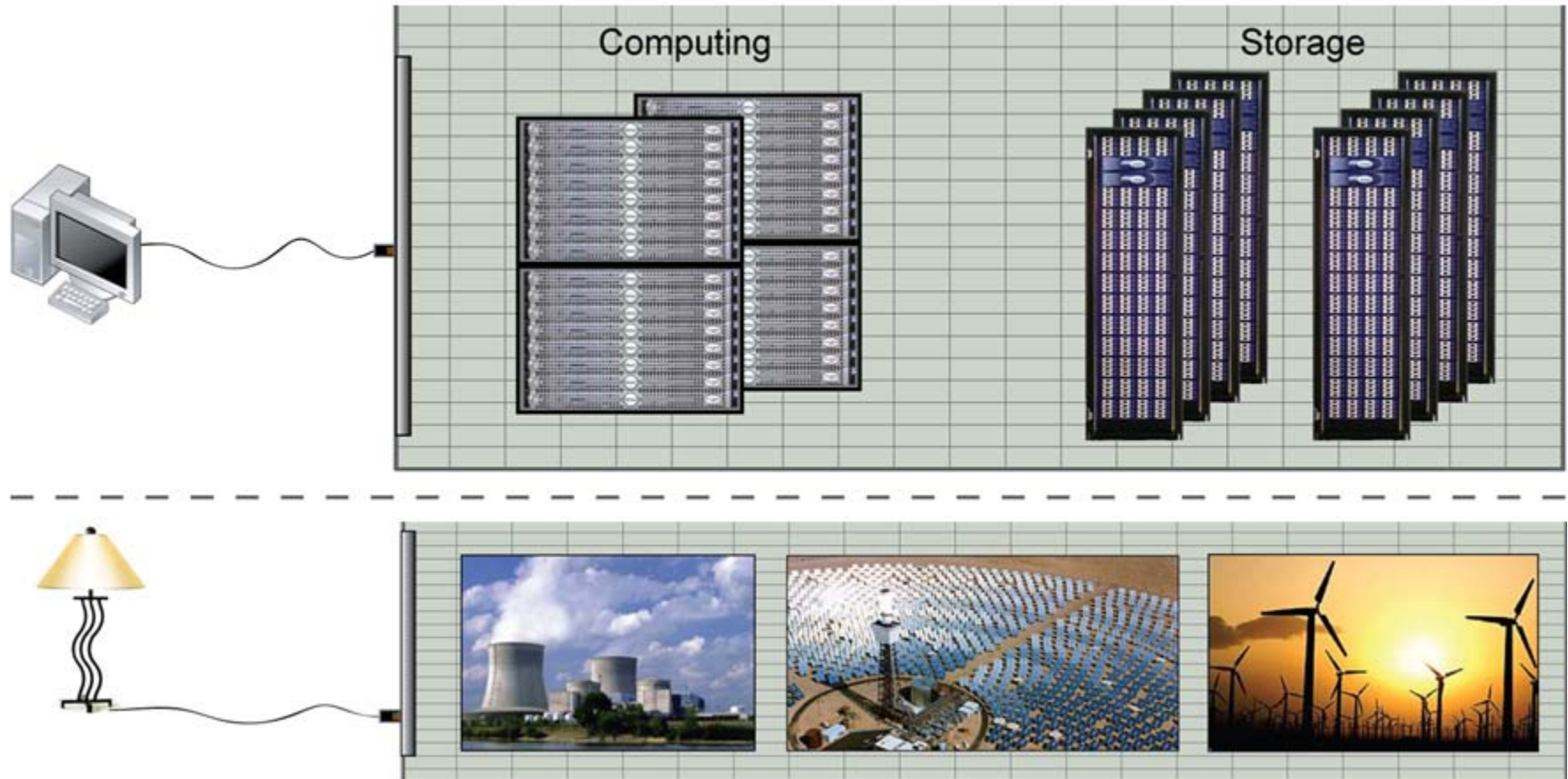
- 资源上限远大于一般应用的需求
- 资源随时可用
- Pay-per-use

### Private Cloud:

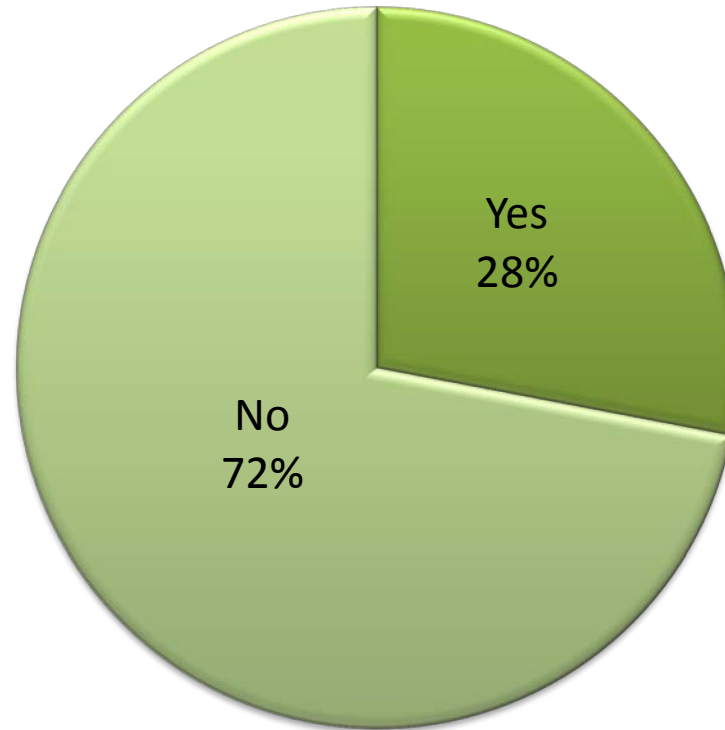
Private cloud refers to a computing environment that provides hosted services to a limited number of people behind a firewall. Such environment for compute and data intensive applications is referred as private cloud for HPC.

# The Vision

HPC clouds is not a new concept, and many HPC users have been are using clouds for long time. With emerging technologies and solutions clouds can serve more users and more applications and brings to live the concept of utility computing



# ISC2009 抽样调查结果

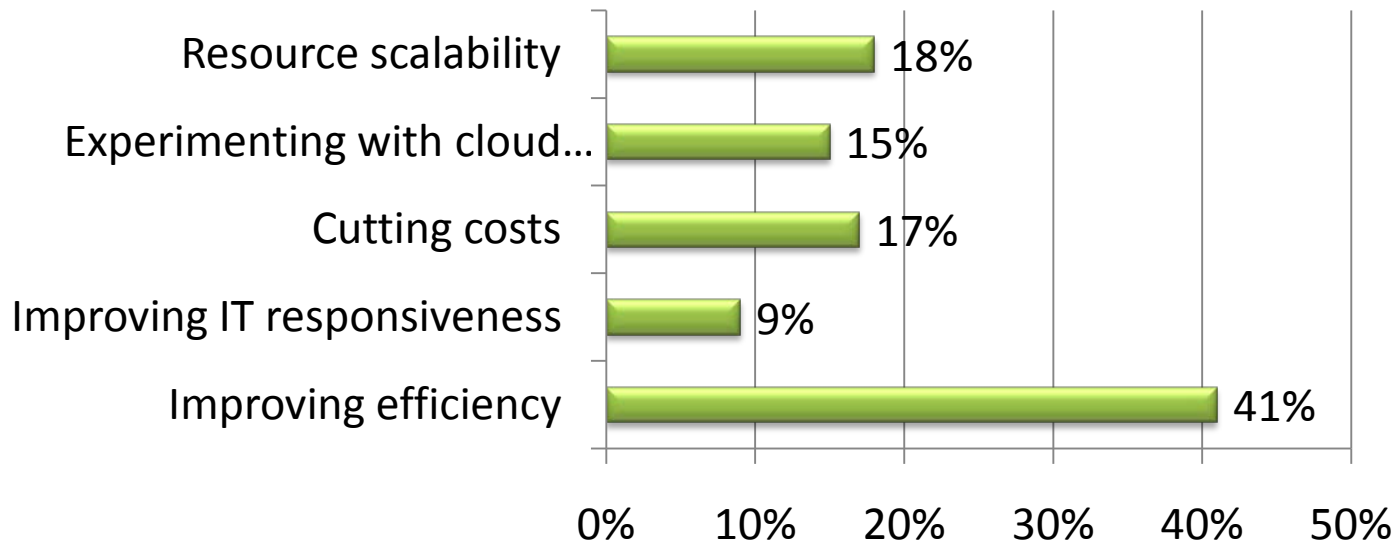


Plans to Deploy Private  
Cloud in 2009

Source: International Supercomputing Conference 2009 attendee survey

# ISC2009 抽样调查结果

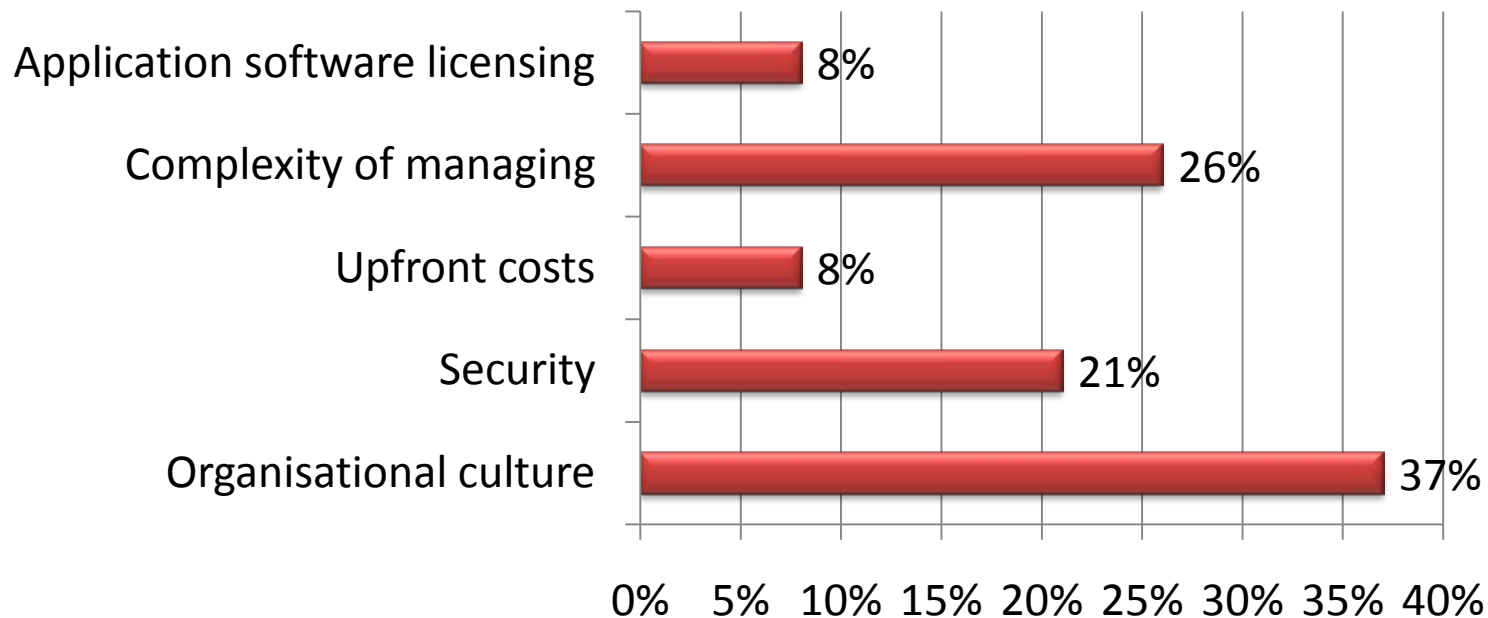
## Motivations for Private Cloud



Source: International Supercomputing Conference 2009 attendee survey

# ISC2009 抽样调查结果

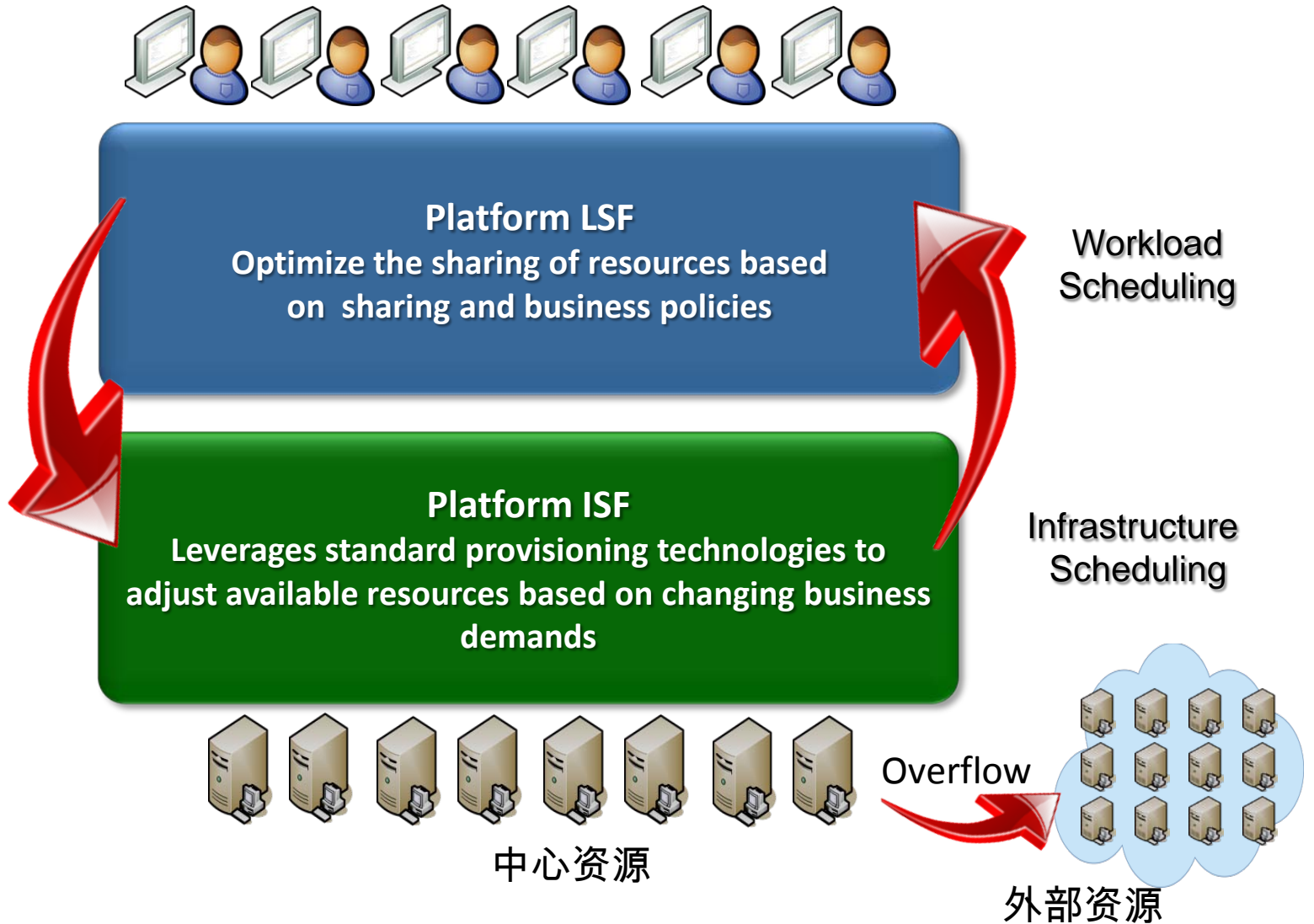
## Barriers to Private Cloud



Source: International Supercomputing Conference 2009 attendee survey

# Private Cloud for HPC 解决方案

Platform Computing



# 为什么云计算现在能实现？

## Provisioning and Virtualization Technologies have evolved Platform solutions

- Platform Cluster Manager, Platform Manage
- OS based provisioning (RHEL, SuSE etc.)
- Multi-boot – boot alternate partition to change node personality
- Diskless – boot memory resident OS, use shared FS
- VMO – dynamically start a required OS in a VM containers

## Industry Solutions

- VMware Virtual Center
- CITRIX XenServer
- Red Hat Xen
- BMC BladeLogic
- OPSware Inc.

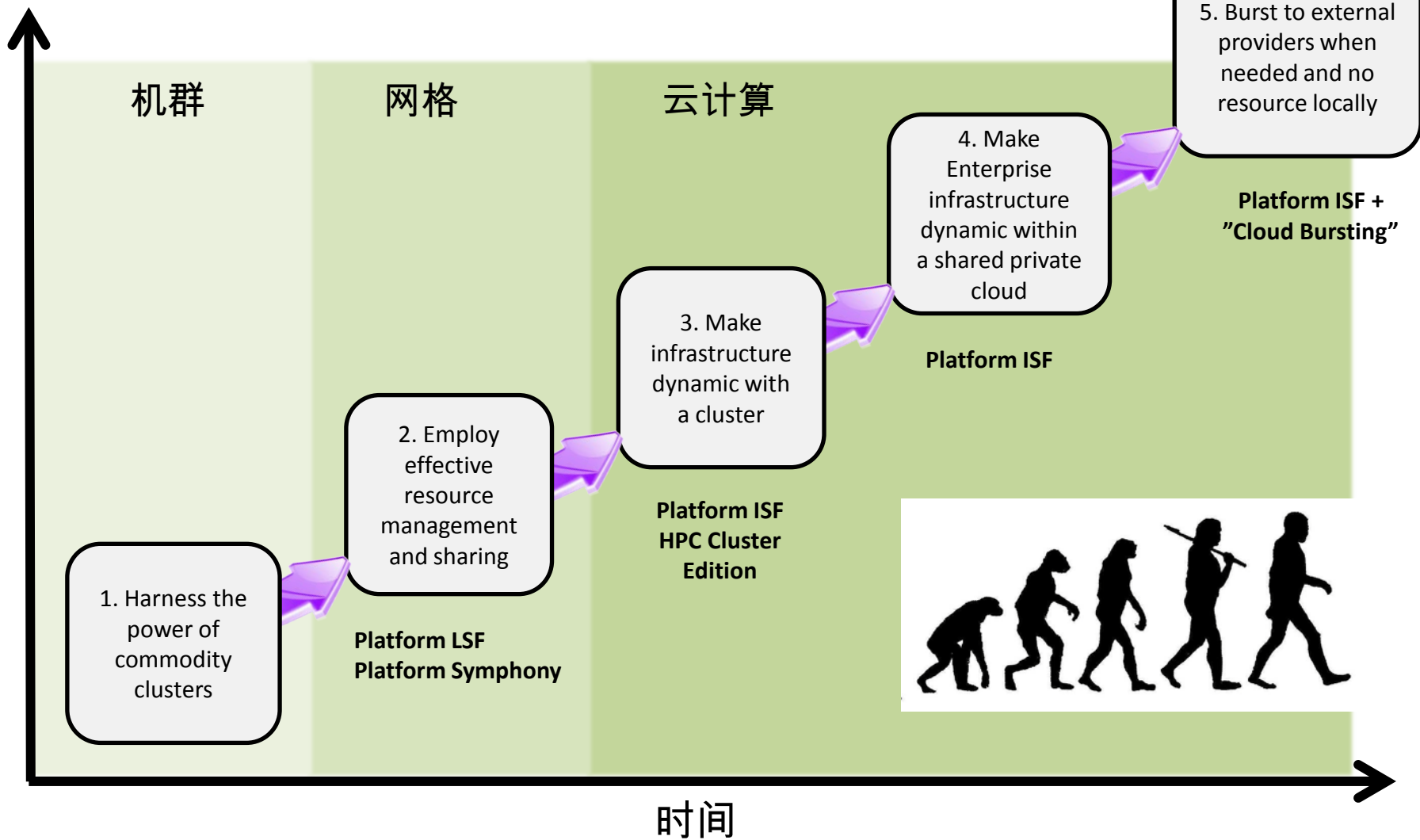


A range of proven solutions exist for provisioning virtual and physical assets. VM technology is now practical for some HPC requirements

# 效率提高的演化过程

Platform Computing

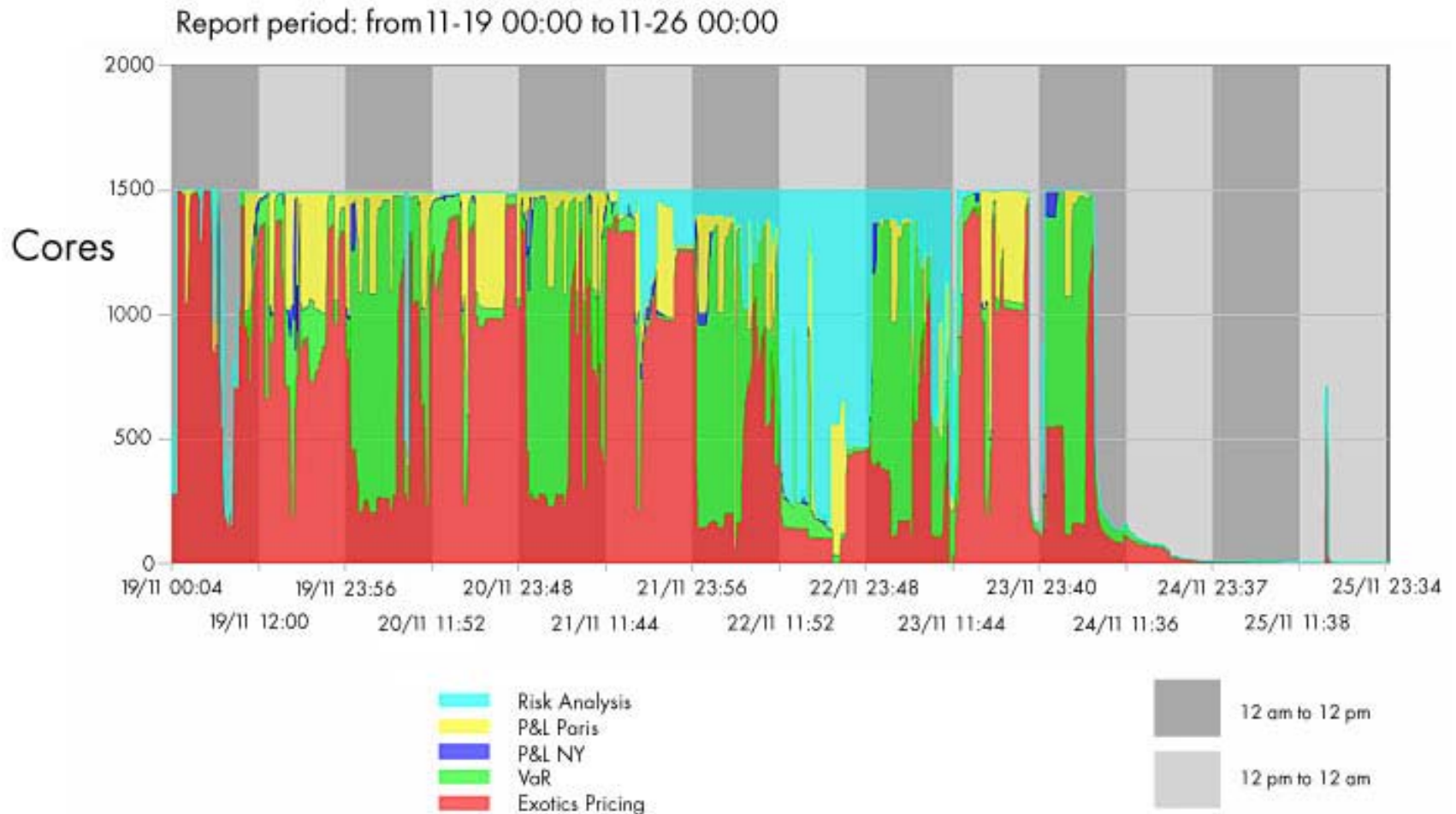
效率, 服务质量



# Production Proven

**Platform Customers are employing Private Cloud Infrastructures today!**

Cluster partition usage over the last week



# HPC Advisory Council 测试实例—HPC 云

{ Platform  
Computing

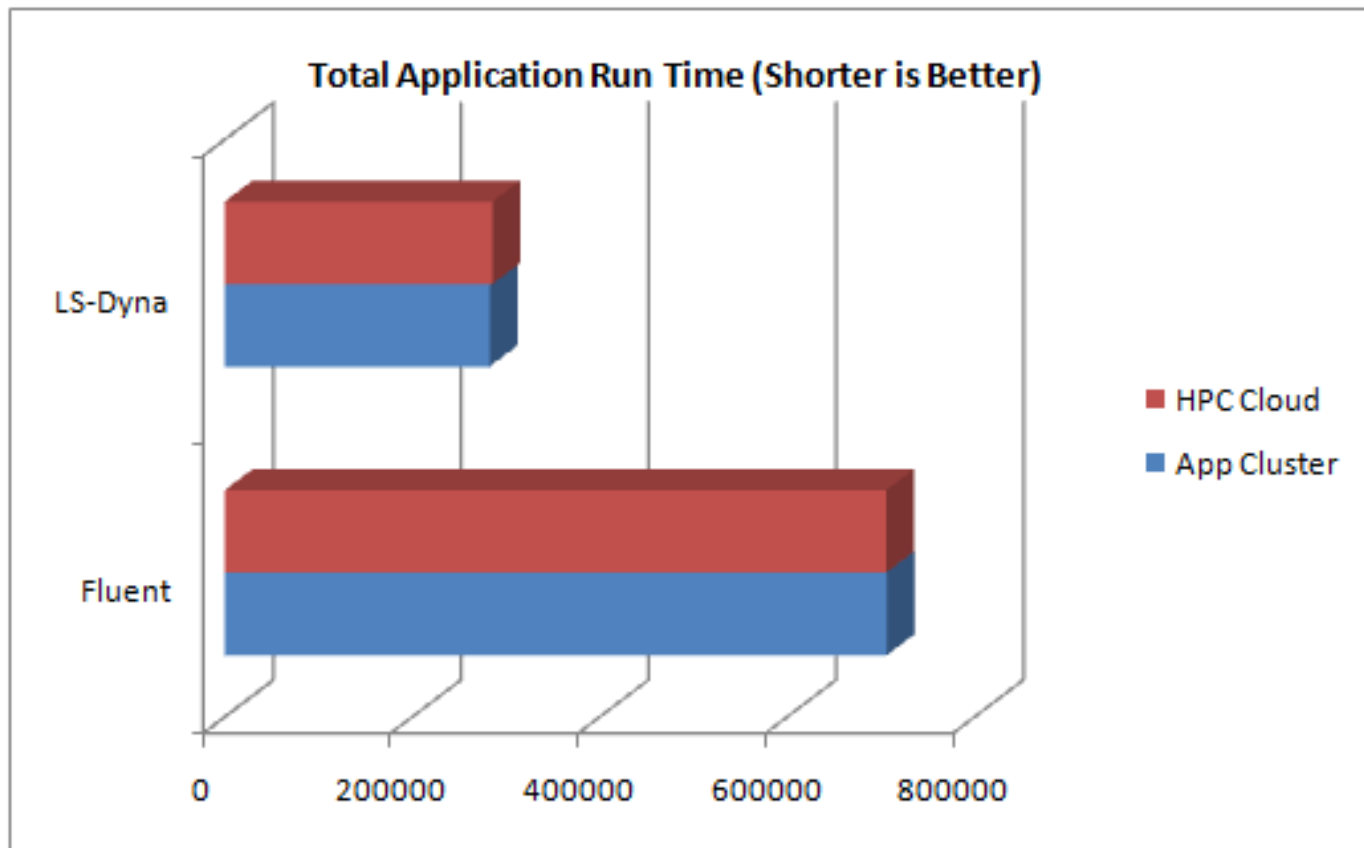
- Dell™ PowerEdge™ SC 1435 24-node cluster
- Quad-Core AMD Opteron™ 2382 (“Shanghai”) CPUs
- Mellanox® InfiniBand ConnectX® 20Gb/s (DDR) HCAs
- Mellanox® InfiniBand DDR Switch
- Memory: 16GB memory, DDR2 800MHz per node
- OS: RHEL5U2, OFED 1.4 InfiniBand SW stack
- Platform LSF HPC v7 update5
- Platform RTM v2



- Three provisioned clusters on Osiris
  - 48 cores Fluent system
  - 48 cores LS-DYNA system
  - 96 cores HPC Cloud system
- Fluent system:
  - 16 Fluent (truck\_14m) jobs with different size and run time
- LS-DYNA system:
  - 16 LS-DYNA (neon.refined.rev01.k) jobs with different size and run time
- HPC Cloud system:
  - Rerun those 32 jobs in the HPC Cloud cluster
- All jobs are submitted by script
- The scheduler keeps the cluster as busy as possible

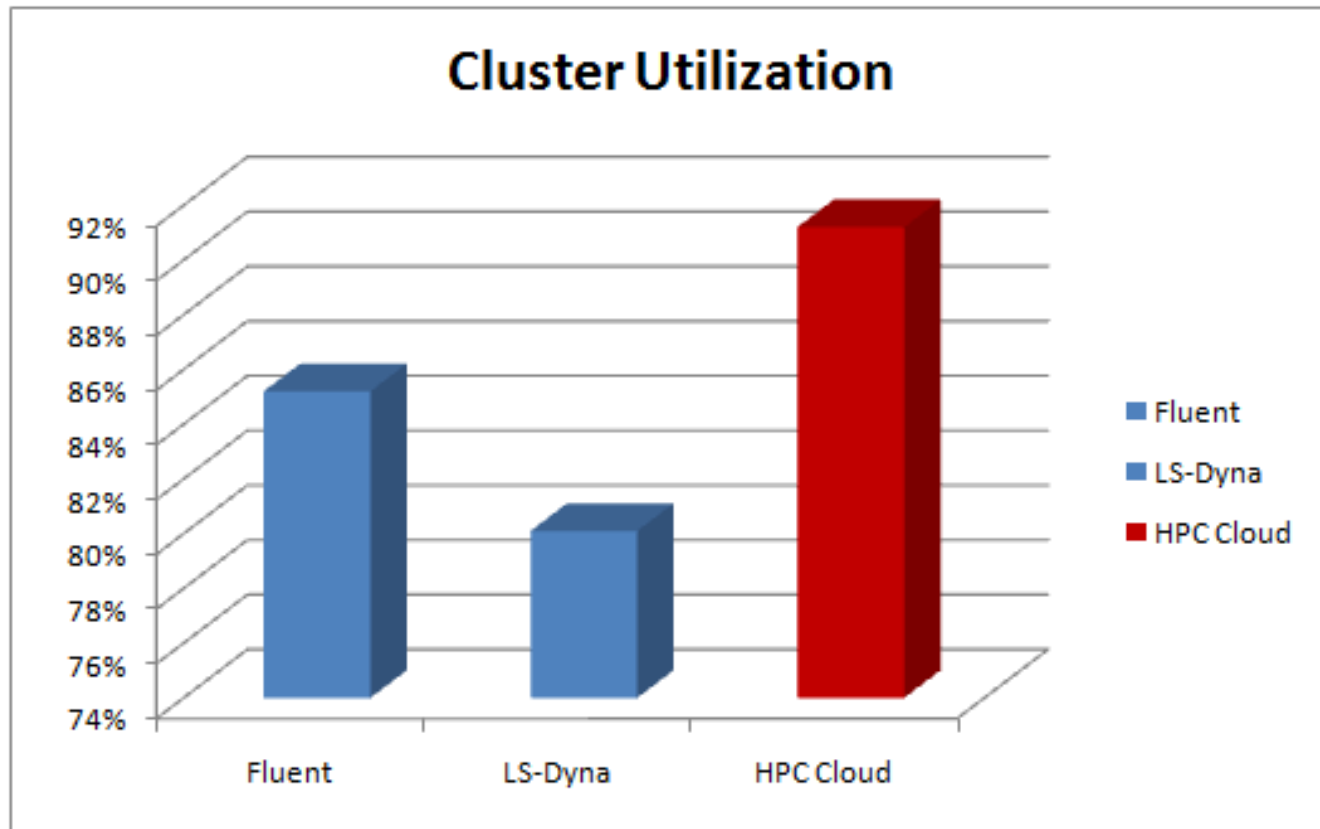
# 性能比较

- 云计算环境保持了应用的性能 – enabling HPC in a cloud

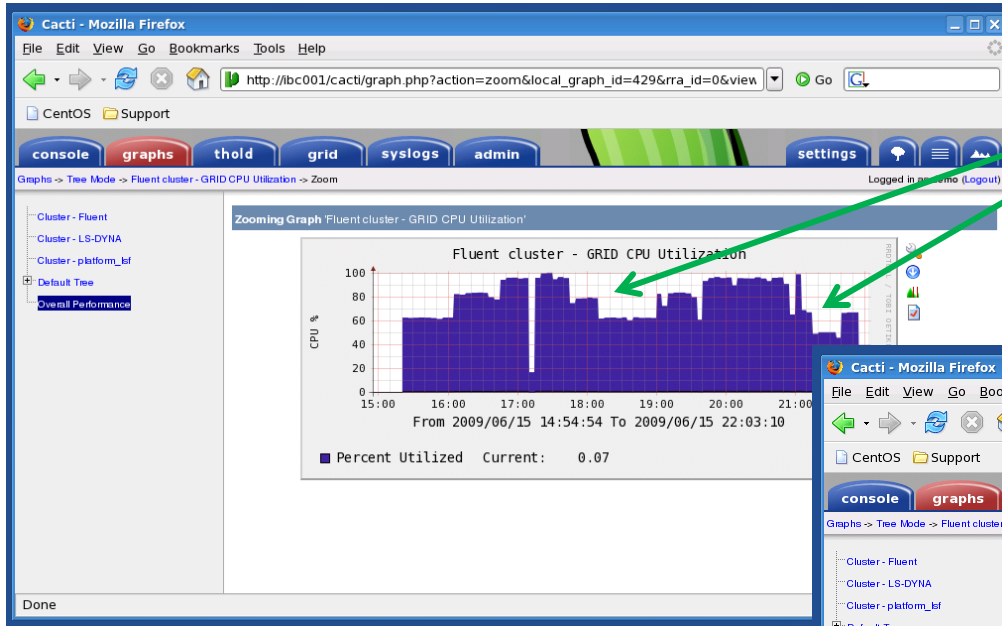


# 系统使用率

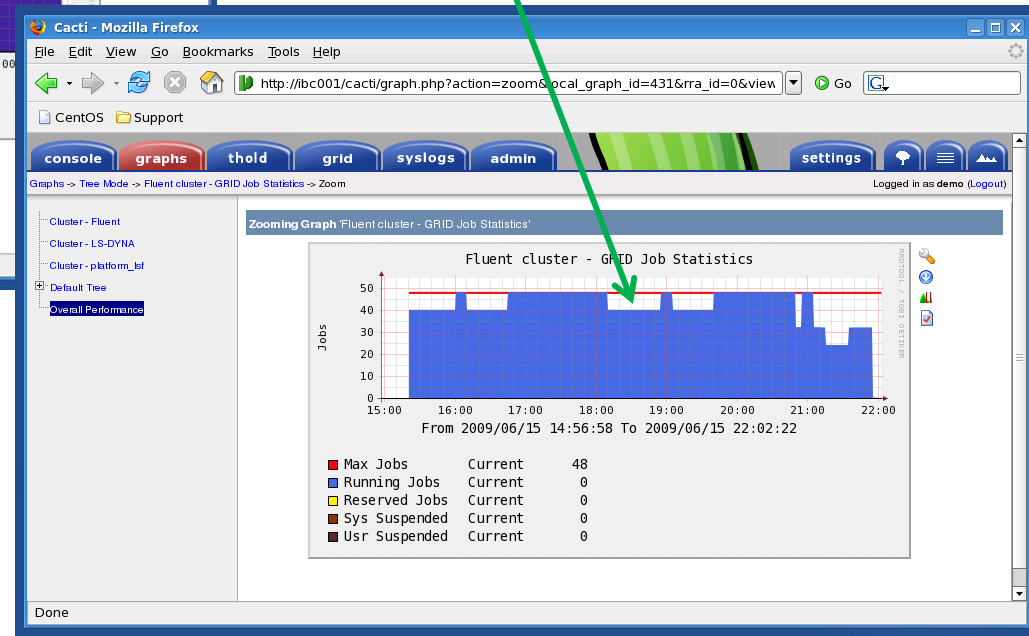
– 云计算的系统使用率明显提高



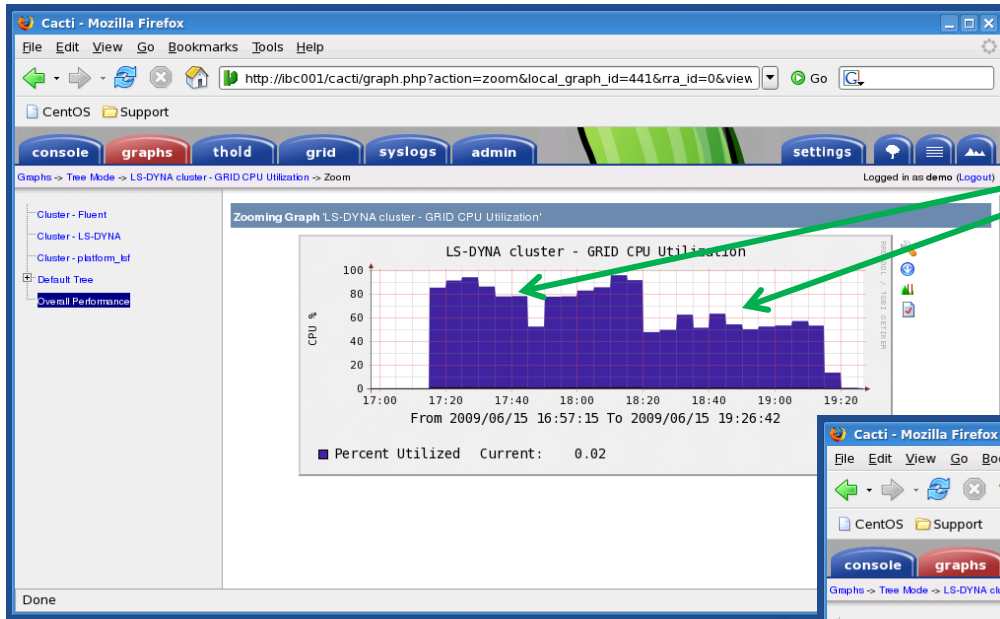
# Fluent - CPU 和系统使用率



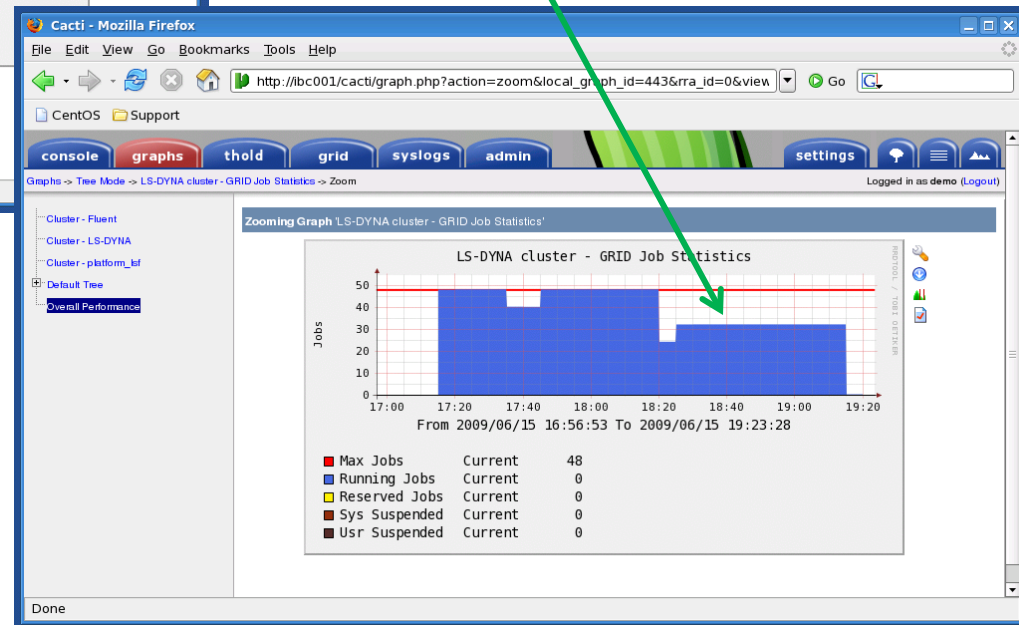
闲置



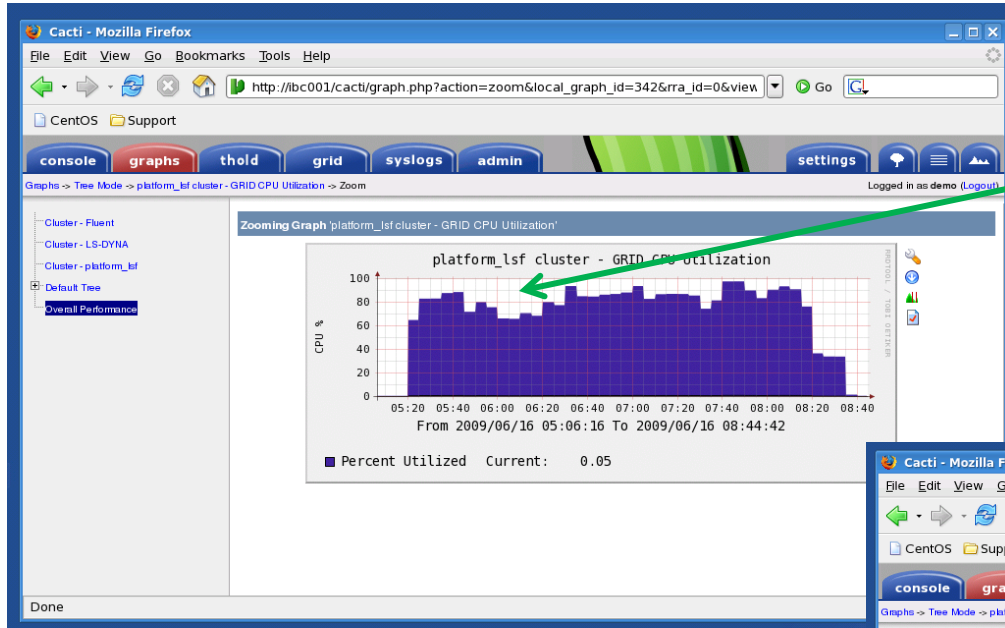
# LS-DYNA - CPU 和系统使用率



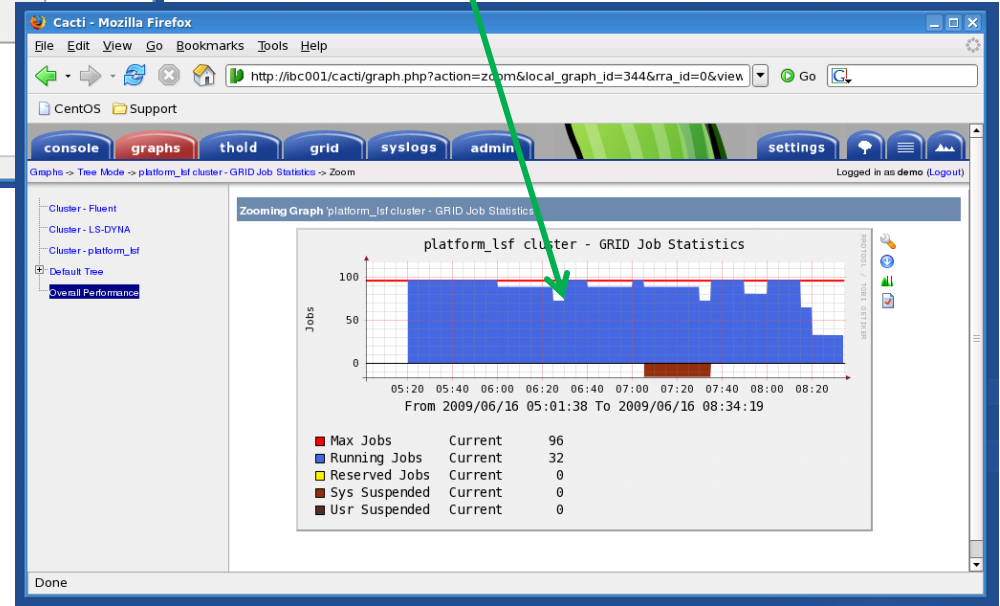
闲置



# HPC Cloud - CPU 和系统使用率



闲置减少



系统使用率提高  
作业等待时间缩短

# 结论

- 云计算设立了用户服务水准的新标准
- 云计算是集群和网络的延伸和演化
  - 动态和弹性
- Private Cloud for HPC 已具备起飞的条件
  - 可行性得到验证
  - 技术走向成熟

The text "Thank You" is centered on a large green rectangular background that occupies the middle and lower portions of the slide. The text is in a large, white, sans-serif font.