

# Server Virtualization: Replacing Fear With Fact



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# Agenda

- Introduction
- SAIC Profile
- Jun 05 – Aug 05: Assessment
- Sep 05 – Aug 06: Pilot to Full Scale
- Sep 06 – Aug 07: Upgrade
- Today
- Q&A

# SAIC Profile

For almost four decades, Science Applications International Corporation (SAIC) has created solutions to complex technical challenges worldwide. A Fortune 500® corporation, we are one of the leading systems, solutions and technical services companies worldwide.

## Our Core Values & Purpose



## Our Successes

### 39 years of continuous growth

- \$8.9 billion in annual revenues for FY 2008
- Fortune 500® company – #298

### Superb staff of qualified professionals

- More than 44,000 personnel worldwide
- 10,000 employees with advanced degrees
- 19,000 with security clearances

### Key positions on initiatives of national importance

- National security
- Intelligence
- Homeland defense
- Cancer research

### Leading provider of contracted R&D services

All figures current as of April 2007.

## Jun 05 – Aug 05: Assessment

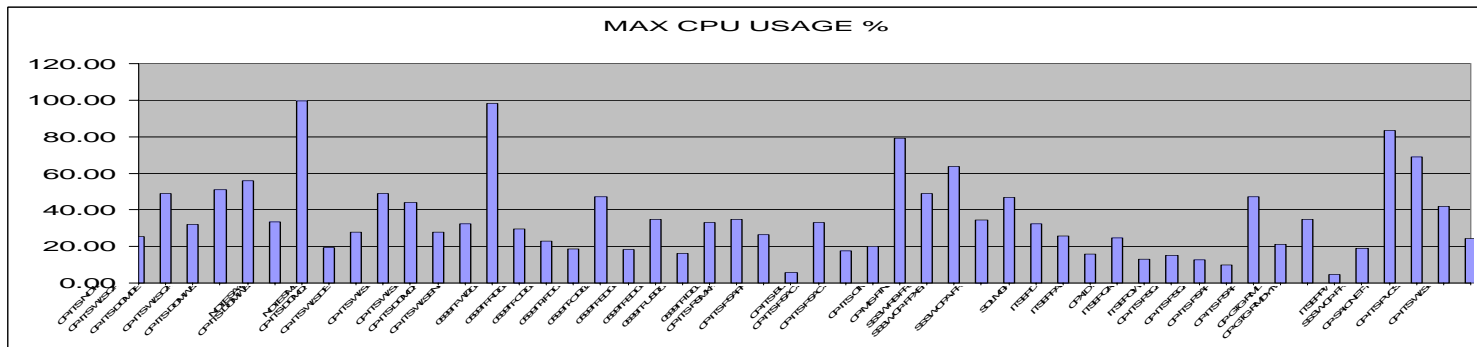
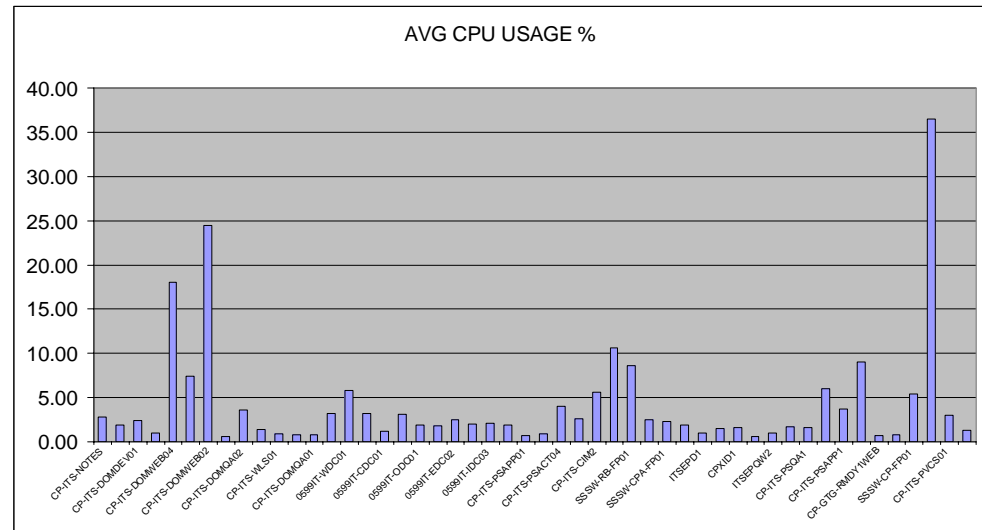
- SAIC ITS briefs chief operations officer and group presidents
  - “Find ways to improve infrastructure and reduce costs”
  - #1 action item - Consolidate data center servers
- Four percent average CPU utilization on data center’s leased servers
  - 300 medium- to high-confidence candidates (low CPU usage, operating system compatibility, compatible peripherals, 3-year leases)
  - Annually missing 35 percent of lease return dates
  - Long hardware procurement times on critical path of application development

# Jun 05 – Aug 05: Assessment

## CPU usage data

Summary of 50 data center servers

Avg CPU usage 4.2 %  
 Highest Avg 36.4 %



## Jun 05 – Aug 05: Assessment

- Faster deployment of new servers; hours not weeks
- No downtime for hardware maintenance, including lease replacements; more uptime of critical systems and services
- Increased efficiency of computing resources; consolidation of idle servers; reduction in power consumption
- Cloning of existing servers for testing and prior to upgrades for rollback
- Change “hardware” (CPU, RAM, hard disk) quickly
- New DR opportunities

# Sep 05 – Aug 06: Pilot to Full Scale

- Data center space savings
  - 15:1 server consolidation
  - 4-10:1 rack consolidation
- Data center cost savings
  - 300 physical servers to 20 virtualization servers
  - Virtualization server is 4.7x cost of basic server (\$28k vs \$6k)
  - 3 yr leased savings of \$1.2M

		Number of VMs		
		Per Server	Per Rack	Per Data Center
<b>2-Way</b>				
Non Virtualized	Instances per server	1	15	990
Virtualized		4	60	3960
		6	90	5940
		8	120	7920
		10	150	9900
<b>4-way</b>				
Non Virtualized	Instances per server	1	8	528
Virtualized		8	64	4224
		12	96	6336
		16	128	8448
		20	160	10560

Fifteen 2-way servers  
(One Rack)



16 VMs  
On  
One 4-way Server



### Assumptions

- Four VMs per processor on a 4-way server
- Fifteen physical servers in the rack plus one additional server migrated

128 Servers  
(Nine Racks)



Eight 4-way Servers  
(One Rack)



### Assumptions

- Four VMs per processor on a 4-way server
- Eight 4-way servers in 1 rack
- 128 VMs in 1 rack

# Sep 05 – Aug 06: Pilot to Full Scale

- Pilot (Sep - Oct 05)
  - Selected four-way versus two-way for more RAM
  - Virtualization server interface to the SAN is hardware-/software-sensitive
- Limited Rate Deployment (Nov 05 – May 06)
  - More SAN space and better capacity / availability planning for VMs
  - “If you build it, they will come” (new projects want VMs)
- Full Rate Deployment (Jun – Aug 06)
  - More formal communication and coordination with other ITS departments
  - Capacity and availability planning continues
  - Demand for VMs from projects and other company initiatives grows



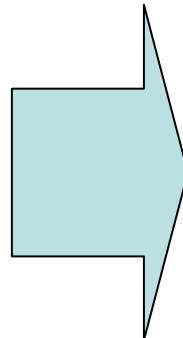
# Sep 05 – Aug 06: Pilot to Full Scale

## 245 servers

\$6,000 ea	\$1.5 million
300 watts ea	74 kW
15 per rack	17 racks
6 cables ea	1470 cables
Provisioning	720 hrs (6 wks)

## 21 servers hosting 245 virtual machines

\$28,000 ea	\$0.6 million
900 watts ea	19 kW
6 per rack	4 racks
12 cables ea	252 cables
Provisioning	4 hrs ea



## SAVINGS

**\$0.9 million**  
**55 kW**  
**13 racks**  
**1218 cables**  
**716 hours**

## Sep 05 – Aug 06: Pilot to Full Scale

- Reduced three-year server lease costs by \$900,000
- Reduced server provisioning from six weeks to four hours
- Met all lease replacement targets
- Reduced data center power use by 20 percent (55 kW)
- Reduced configuration errors through reusable VM templates
- Used VM “cloning” of existing servers for support of general testing and upgrade proof-of-concepts
- Slowed growth of new hardware leases
- Managed SAN space needed for projected growth

# Sep 06 – Aug 07: Upgrade

## Full Scale Lessons Learned

- Demand for VMs driven by real-time provisioning and ease of use
- Performance monitoring showed excessive over use of existing hardware
  - Result One: High CPU wait times for highly utilized VMs causing slower response times for end users
  - Result Two: Increase in memory swap at the virtualized server level also caused slower response time
- Team was spending disproportionate amount of time tuning at the virtualized server and VM layers to address response times

## Sep 06 – Aug 07: Upgrade

- Full Scale Lessons Learned
- Solution to “Demand-Performance” challenge
  - Based on a new Capacity Planning Model
    - Fixed number of units per virtualized server (VI Units)
    - Standard VM profiles
- Solution Outcome
  - Improved response times
  - Significant reduction in time spent on performance tuning

# Sep 06 – Aug 07: Upgrade

## Full Scale Lessons Learned

- Capacity Planning Model example
  - One virtualized server host
    - 4-way (dual core) with 32 GB server
    - Delivers 32 VI units of capacity
  - 32 VI Units consumed by VM profiles
    - 6 Mediums VMs (6 x 1 = 6 VI units), e.g., web server
    - 5 Large VMs (5 x 2 = 10 VI units), e.g., domain controller
    - 4 XL VMs (4 x 4 = 16 VI units), e.g., application server
    - Result: 15 VMs provisioned (6 + 10 + 16 = 32 VI units)

	VM Profiles					
	Small	Medium	Large	XL	2XL	3XL
<b>VI Units</b>	0.5	1	2	4	8	16
<b>Virtual CPUs</b>	1	1	1	2	2 to 4	4
<b>Memory</b>	512 MB	1024 MB	2048 MB	3600 MB	8 GB	16 GB

# Sep 06 – Aug 07: Upgrade

- Upgrade Strategies
  - Early functional testing in sandbox environment
  - Wait for first minor release
    - Planned - Burn in and address major bugs, if any
    - Surprise – Upgrade enabled move of individual VMs to new upgraded environment without downtime
  - Move to strong isolation of virtualized server hardware in Dev, QA, and Prod
    - Move Dev, QA, and Prod VMs into separate clusters
      - Non Prod VMs could not effect Prod VMs, i.e., resource load
      - Clear migration for patches (Dev → QA → Prod)
    - Positioned team to migrate Dev VMs first, then QA, Prod

## Sep 06 – Aug 07: Upgrade

- Migration method
  - Upgraded the VM management system
  - Installed upgrade on new hardware and placed in existing cluster
  - Moved VMs from old to upgraded environment with no downtime
  - As each server was freed up, rebuilt with upgrade
- 397 VMs migrated by environment onto 37 hosts
  - 118 Dev VMs (3/5 - 3/16, two weeks)
  - 105 QA VMs (3/19 - 3/30, two weeks)
  - 174 Prod VMs (4/2 - 4/13, two weeks)
- Mix of Web, application, authentication, and (low transaction) database servers

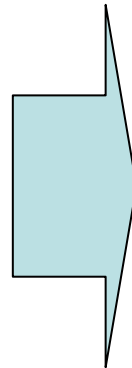
# Today

## 586 servers

\$6,000 ea	\$3.52 million
300 watts ea	176 kW
15 per rack	40 racks
6 cables ea	3,516 cables
Provisioning	720 hrs (6 wks)

## 61 hosts for 586 virtual machines

\$31,000 ea	\$1.89 million
900 watts ea	55 kW
6 per rack	11 racks
12 cables ea	732 cables
Provisioning	4 hrs ea



## SAVINGS

**\$1.63 million**  
**121 kW**  
**29 racks**  
**2784 cables**  
**716 hours**

# Today's Opportunities

- Process improvement
  - Repeatable builds
  - Recurring tasks
  - Benchmarking
- Virtualizing clients
  - Managed Desktop program

# Q&A

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