SOLUTIONS

Data Center Consolidation

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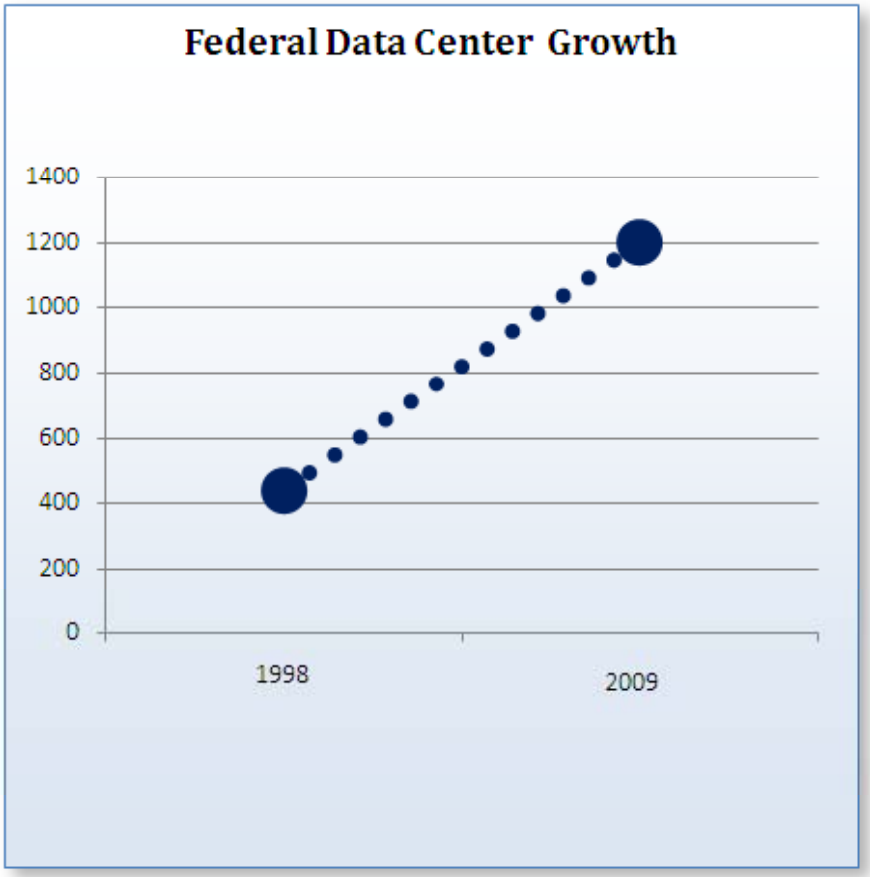
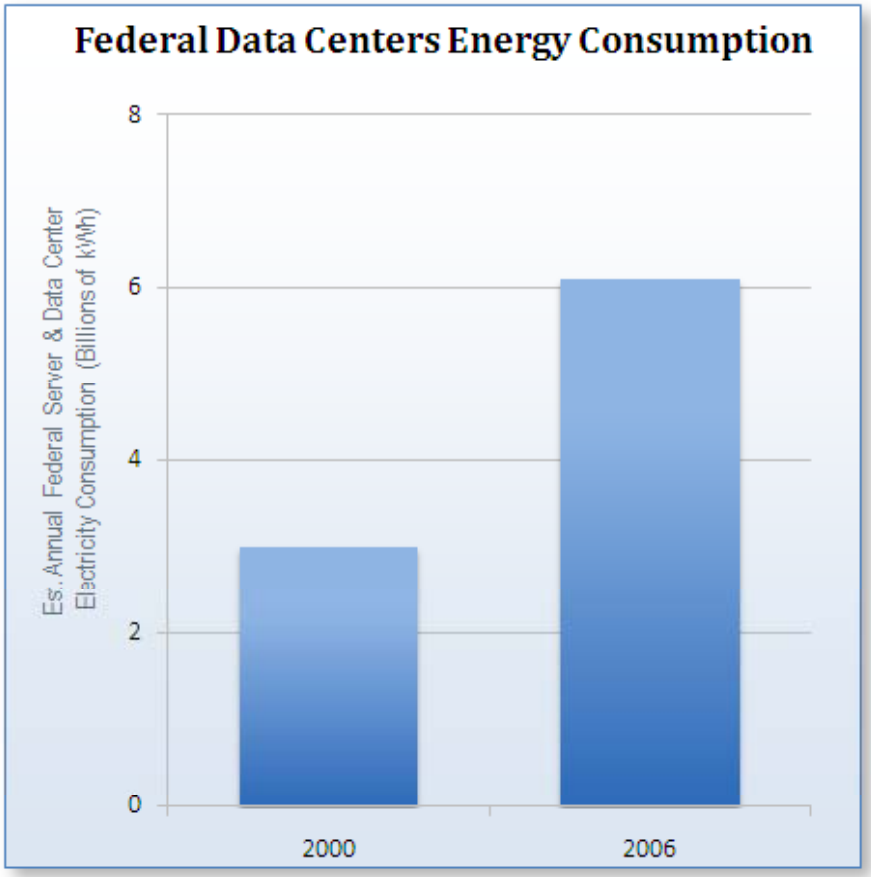
Agenda

- Why Data Center Consolidation ?
- Data Center consolidation recommendations
- Choosing appropriate assessments, tools & technologies for data center consolidation planning
- Best Practices in Data Center Consolidation

Why Data Center Consolidation ?





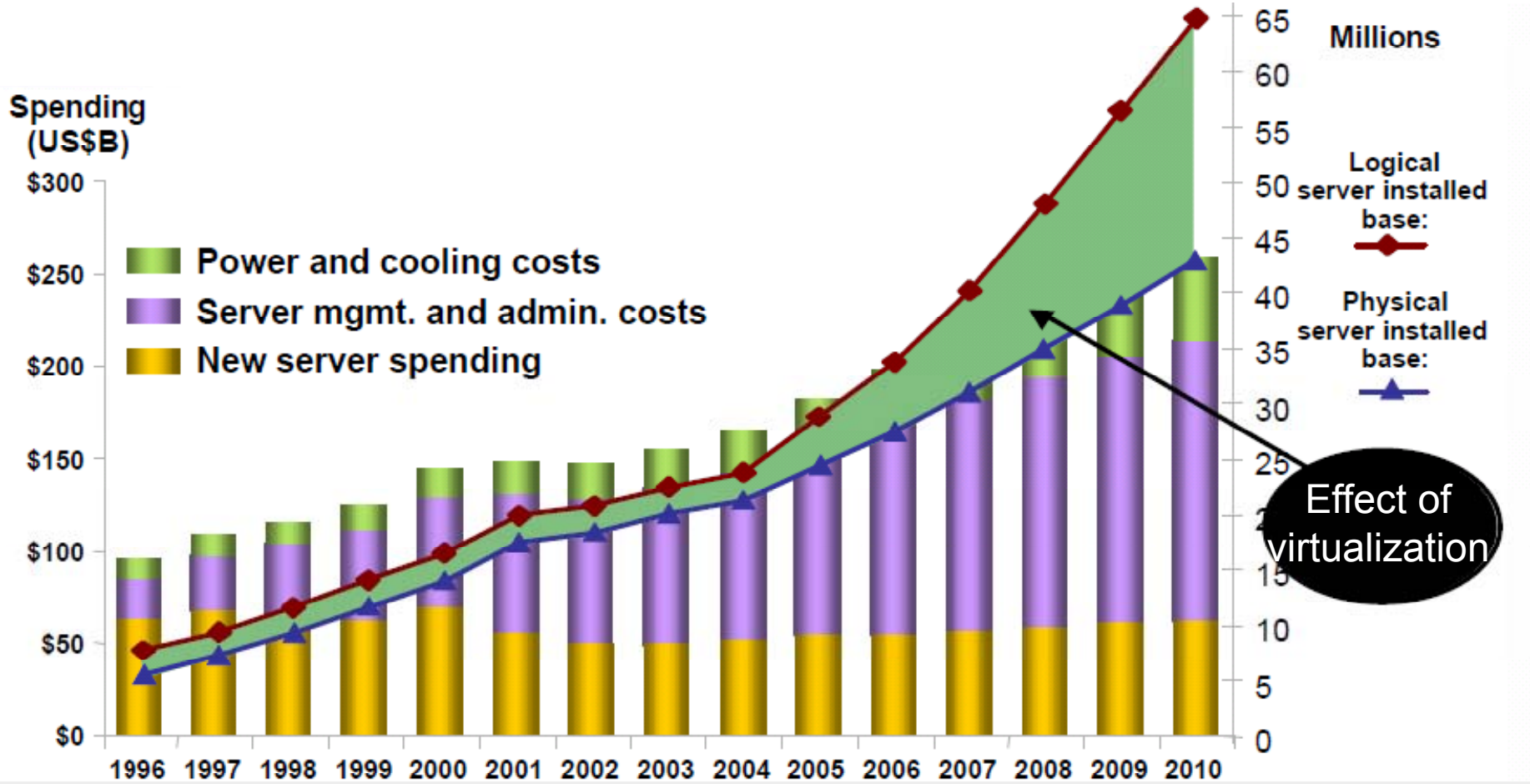
SOURCE: Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431, U.S. Environmental Protection Agency ENERGY STAR Program, August 2, 2007

Data Center Consolidation

- Consolidate 1100+ data centers
- Reduce energy consumption
- Reduce the costs of hardware, software, and operations

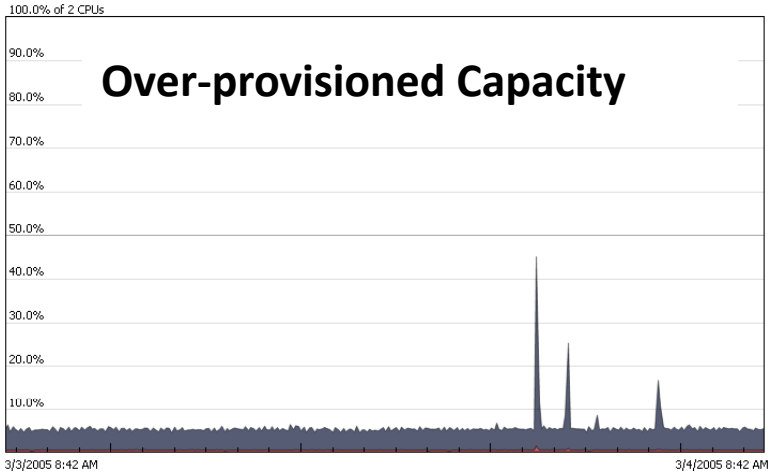
Data center economics

Infrastructure spending is flat, management costs are rising



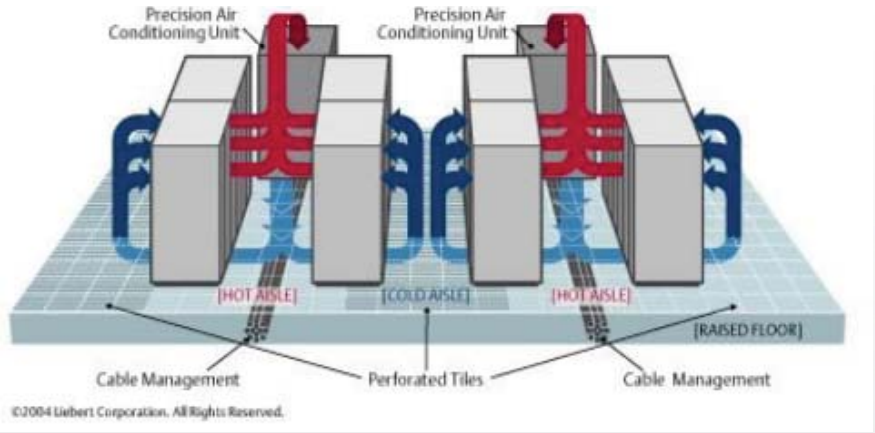
Source: IDC, "CIO Strategies to Build the Next Generation Data Center," Doc # DR2007_5VT, February 2007.

Today's Data Center Model is Broken



Over-provisioned Capacity

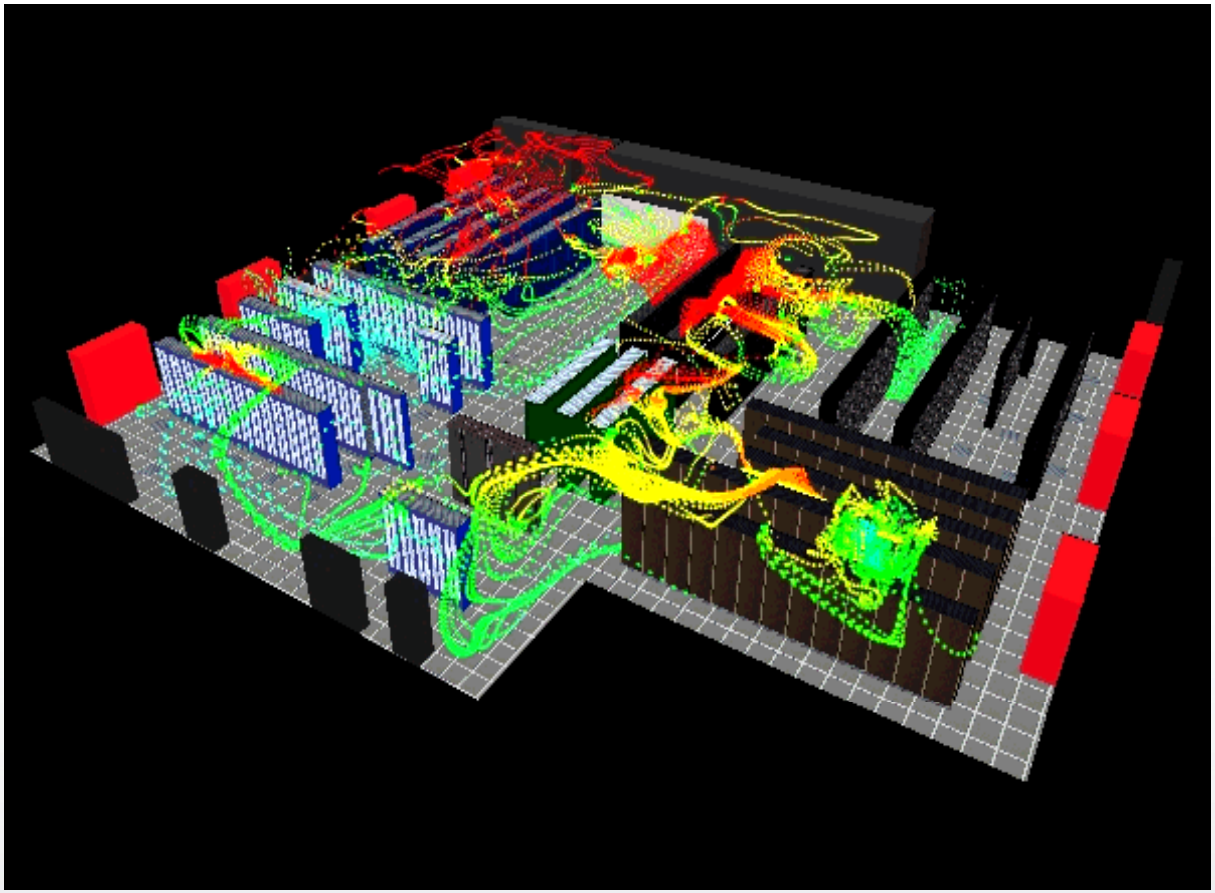
Inefficient Datacenter Design



- Poor forecasting + low flexibility = excess capacity
- Typical datacenter: 3 years excess server capacity
- Servers consume >50% of average power when idle
- Datacenters are outdated and hugely inefficient
- Cooling servers often requires 2x the power consumed
- Servers DOUBLING every 5 years
- Network Devices DOUBLING every 2 years
- Terabytes of Storage DOUBLING every 1 year
- $2 – $3 spend on management for every $1 spend on hardware*

Where Does the Power Go?

Power Consumption in the Datacenter



Server/Storage	**50%**
Computer Rm. AC	**34%**
Conversion	**7%**
Network	**7%**
Lighting	**2%**

Compute resources and particularly **servers** are at the heart of a complex, evolving system!

Source: APC

KEY CHALLENGES WITH TODAY'S DATA CENTER

SERVER SPRAWL

- Outdated view of each server running each application leads to wasteful powering of servers only operating at 20% capacity. Energy wasted on spinning fans.

INCREASED IT DENSITY

- Average IT Rack Density has increased from 2-3kW per rack to over 10, with some racks reaching over 20kW, even over 30kW with Blade Servers

OUTDATED, WASTEFUL RAISED FLOOR COOLING METHODS

- Air Distribution Air Handling Fans are very power hungry and must move air great distances with outdated raised floor cooling
- Raised Floor cooling cannot effectively, efficiently handle today's IT Density
- Almost always not able to vary cooling intelligently with dynamic, changing heat-load.

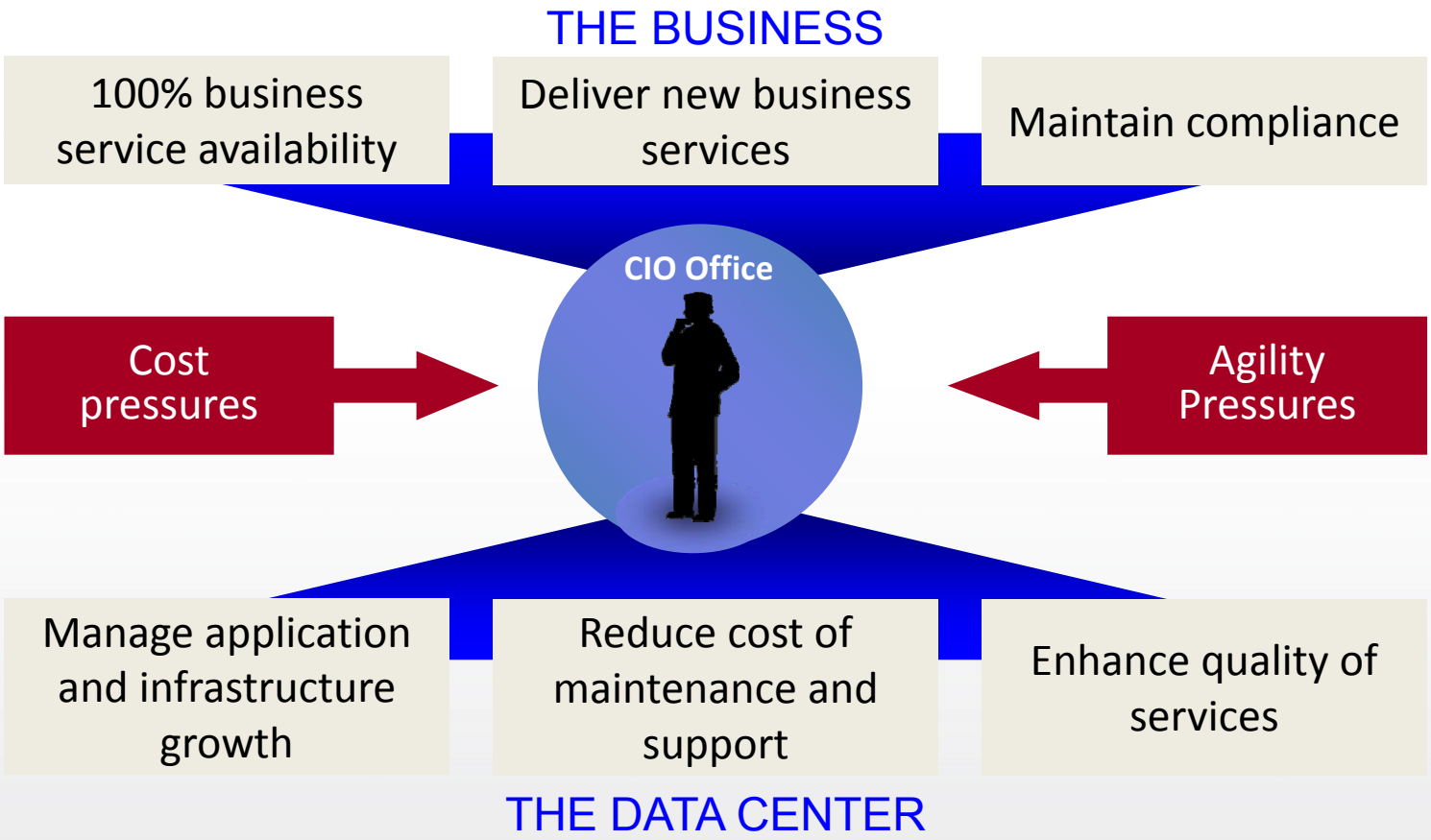
WASTEFUL POWER INFRASTRUCTURE

- Oversized for growth plans, because often not modular, scalable

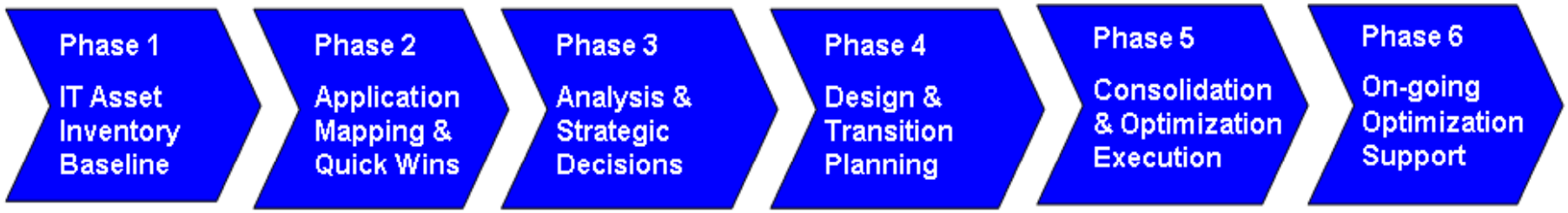
NO PROACTIVE MANAGEMENT OF ENERGY EFFICIENCY

- Tools exist today to monitor Electrical Efficiency of Data Centers, but most have not employed them. They're flying blind to how electrically efficient their data centers are operating.

Data center priorities: reduce costs, increase agility



Data Center Consolidation Approach



ACTIVITIES

- Create an inventory of HW/SW assets by data center
- Capture Baseline Metrics for utilization & energy for each data center

- Map Applications:
- ✓To Server/Mainframe
- ✓To Database/Platform
- ✓App Dependencies
- ✓App Security
- ✓App Usage & SLAs
- ✓Segment Architecture
- Quick Wins

- Perform energy and cost evaluation of different approaches
- Identify the risks, alternatives, cost assumptions and business benefits
- Make strategic technology & consolidation investment decisions

- Design & test consolidation alternatives
- Develop transition plan for energy use optimization & data center consolidation
- Create project plan and WBS for the transition plan

- Execute virtualization, consolidation and migration plans
- Execute energy use optimization plans
- Measure and report on Utilization and Cost Savings Metrics

- Continue energy use optimization, virtualization and consolidation
- Continue on-going monitoring and reporting of Utilization and Cost Savings Metrics

DELIVERABLES

1. *IT HW/SW Asset Inventory & Baseline Metrics*
2. *Application Mapping & Quick Wins*
3. *Consolidation Analysis & Strategic Investment Decisions on Standard Platforms and Services*
4. *Consolidation Design & Transition Plan*
5. *Consolidation Execution & Progress Reports*
6. *Semi-annual Metrics Reports*

Key Activities

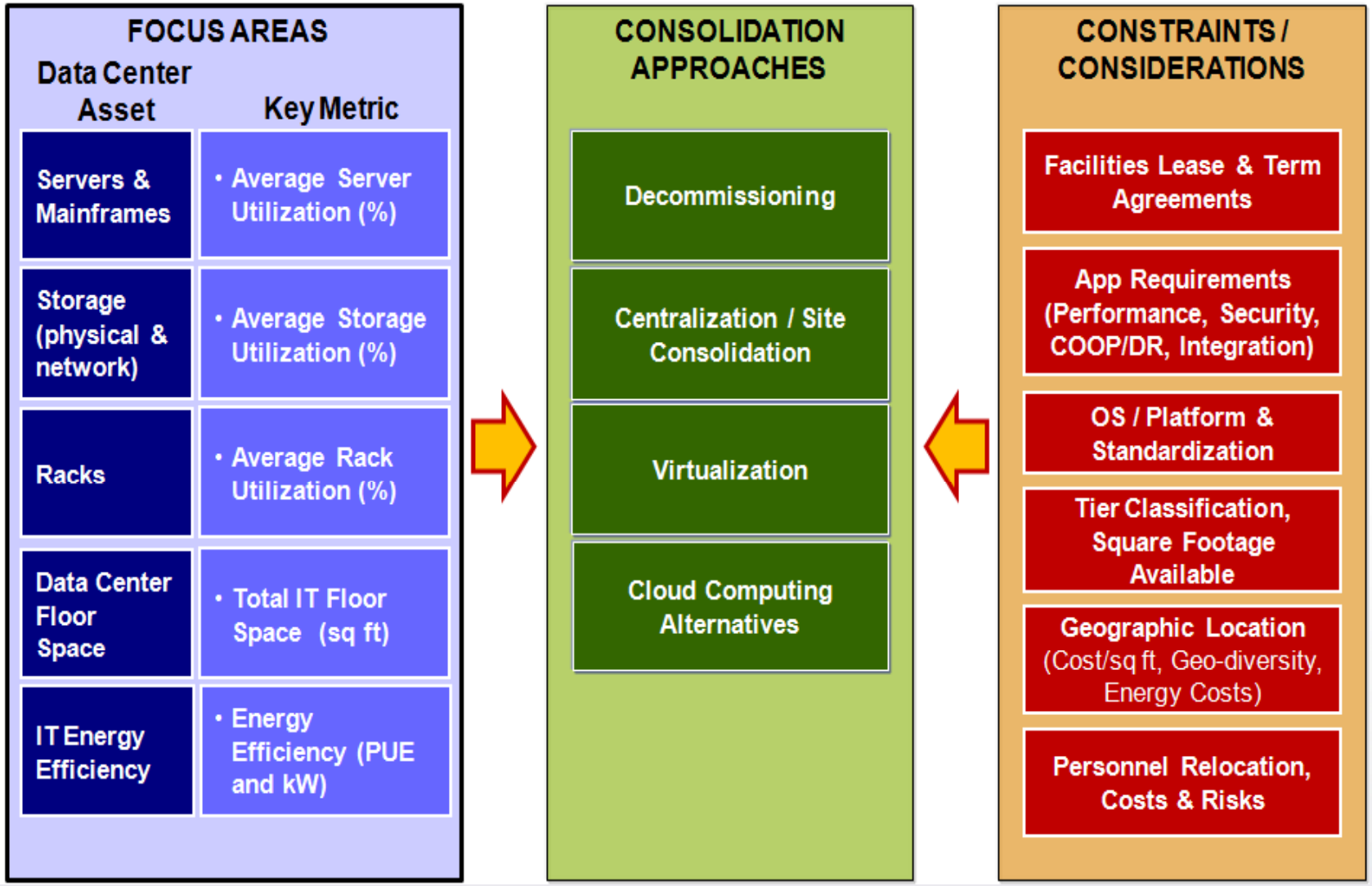
Agency-driven Activities

- Establish Data Center Baseline by Conducting Hardware and Software Inventory
- Develop Agency Data Center Consolidation Plan and Schedule
- Map, Analyze Systems and Make Strategic Long-term Investment Decisions
- Design, Implement and Test Agency-specific Consolidation Solutions
- Execute the Agency Data Center Consolidation Plan

OMB-driven Activities

- Identify Strategic Goals & Define Government-wide Metrics and Target Objectives
- Collect Agency Data, Derive Criteria and Analytics for Utilization & Savings
- Analyze Critical Success Factors in all Four Key Impact Areas
- Based on Comparative Analysis Approve Agency Data Center Consolidation Plans

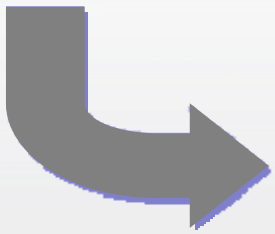
Consolidation Approaches



Key Impact Areas

Data Center Network (Not Included in Analysis)

- Local Area Networks
- Virtual Private Networks
- Wide Area Networks



Operations & Management

Data Center IT Software Assets

- **Middleware**
  - » Database Servers
  - » Web Servers
  - » Application Servers
  - » Message Queues
  - » Directory Services
  - » Other Middleware
- Applications, Platforms, Services
- VMs

Data Center Hardware Assets

- Physical Storage / Network Storage
- Special Purpose Hardware
- Physical Servers / Mainframes
- Switches, Routers, Firewalls
- High Speed Local Networks
- Racks, Shelving and Cable Plant

Data Center IT Facilities and Energy

- HVAC / Cooling and Energy Consumption
- Power Management & Distribution
- Power Source & Alternative Power Supplies

Data Center IT Geographic Location & Real Estate

- Building Leases, Available Floor Space
- Geographic Location of Data Centers

Implementation Plan

Approach	Description	Potential Benefits	Rationale
Decommission	Turn off servers that are not being used or used in-frequently (e.g. dedicated development environments)	• Cost Savings • Energy Efficiency • Frees Floor / Rack Space	• As many as 10-15% of servers may be inactive but still powered on in data centers*
Centralization / Site Consolidation	Move servers/storage to a few selected data centers Consolidate small data centers to larger target centers	• Floor Space Cost Savings • Operational Cost Savings • Increase Rack Utilization • Energy Efficiency	• Approximately 430 Government data centers are categorized as "closets" or small sized data centers (less than 1,000)**
Virtualization	Consolidate several servers onto a single server through virtualization of the OS/Platform	• Floor Space Cost Savings • Increase Rack Utilization • Increase Server Utilization • Energy Efficiency	• Server Utilization is approximately 21% Government wide**
Cloud Computing Alternatives	Move application functions to standard, vendor supported enterprise platforms or services	• Floor Space Cost Savings • Energy Efficiency • Operational Cost Savings • Cap Ex Cost Savings HW/SW • Reduced SW Maintenance • Improved Service Delivery	• Reduce Operational Risk, lower TCO and TCSD • Approximately 40% of Civilian Agency Systems are low-impact FISMA security, and therefore may be low-risk candidates for Cloud Computing solutions

** McKinsey Report: Revolutionizing Data Center Efficiency, July 2008*

*** OMB BDR 09-41 Data Analysis, October, 2009*

Phase 1 : IT Asset Inventory Baseline

IT Software Assets & Utilization

- ✓Software Asset Management & DSL
- ✓Release Management & SDLC
- ✓Service, Application Mapping to Segment Architectures and Enterprise Platforms
- ✓SOE = SOA + Virtualized Infrastructure
- ✓Categorized Services / Cloud Computing

Geographic Location & Real Estate

- ✓Low risk for disasters, moderate climate
- ✓Low population density / low cost
- ✓Large GSF / expansion potential
- ✓Proximity of energy / cooling sources
- ✓Abundant network connectivity

IT Hardware Assets & Utilization

- ✓Hardware Asset Management & CMDB
- ✓Change Management & CCRB
- ✓Energy Star Hardware Standardization
- ✓Network, Server, Storage Virtualization
- ✓Service Automation

IT Facilities & Energy Usage

- ✓Air / liquid economizers, optimal airflow
- ✓High-efficiency CRAC units, chillers, fans
- ✓Energy source type / gas emission factor
- ✓Data center tier, floor type, cable plant
- ✓Power management / back-up

Phase 2 : Application Mapping

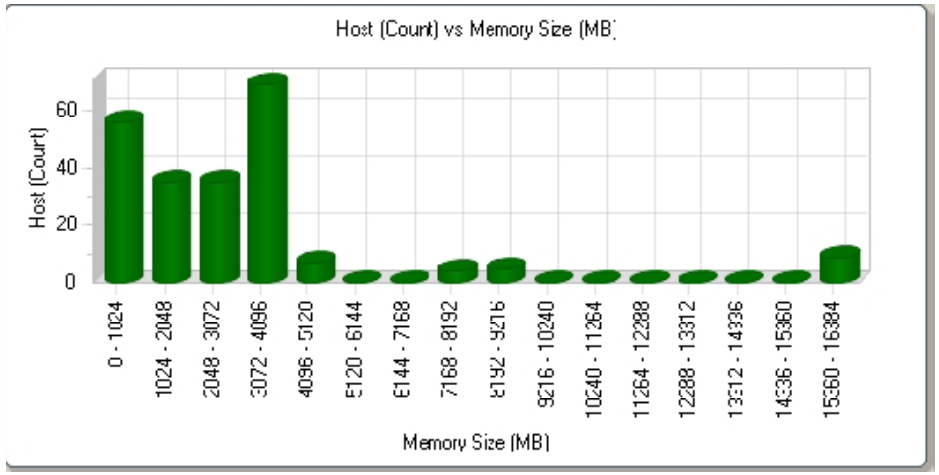
- ✓ Migrate low security impact applications to Cloud Computing technologies
- ✓ Identify business applications that have not been used in the past year and decommission

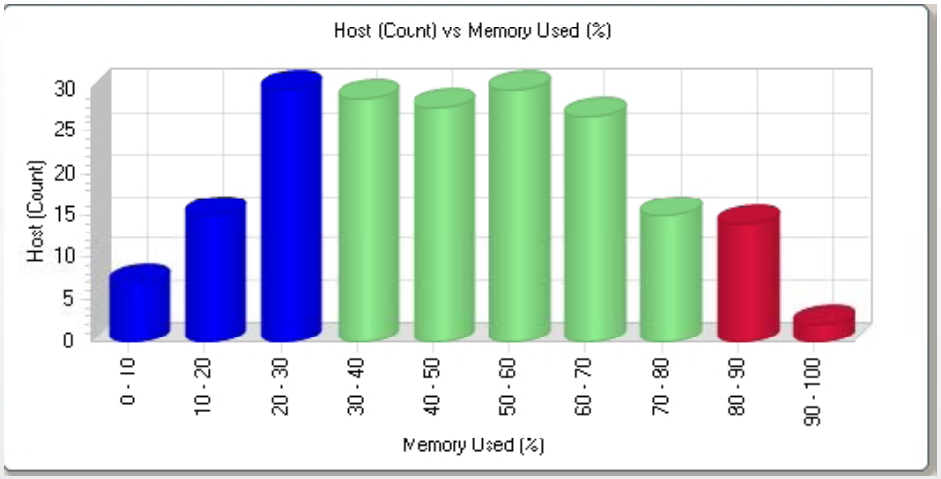
- ✓ Identify servers with average / peak utilization of 0% over the past month and power them down (can be turned on upon request if necessary)
- ✓ Initiate server and storage consolidation via virtualization whenever possible

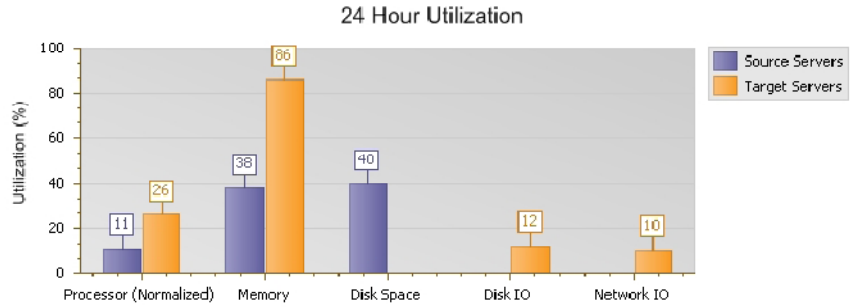
- ✓ Raise operating temperature in the data center to 74°F – 78°F (best practice)
- ✓ Improve cooling air circulation by cleaning under floor obstructions and by using ducted airflow

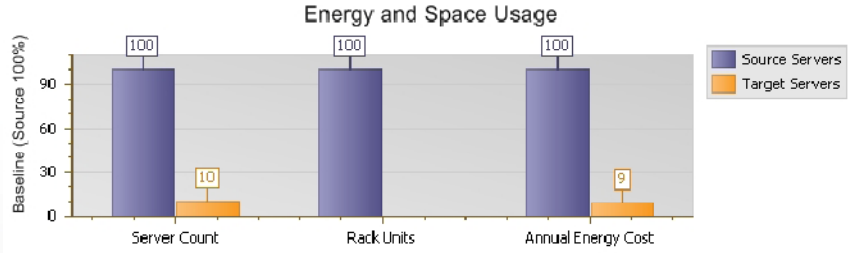
- ✓ Consider cooling opportunities with filtered outside air (at night / cool seasons)
- ✓ Consider using own power generation during peak demand & selling power capacity to grid

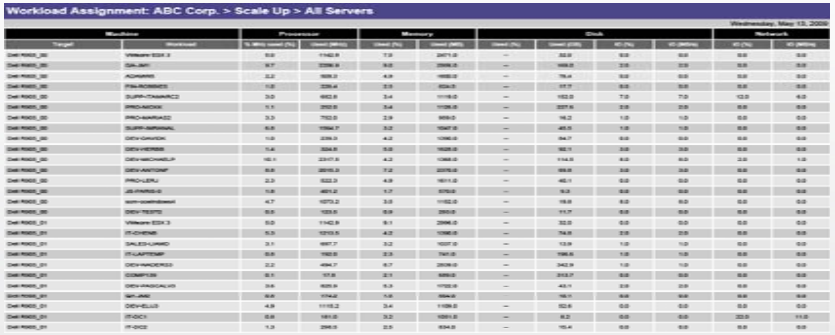
Data Center Assessment











Inventory Summary Report

Inventory Summary

Powered by PlateSpin. Workload Management from Novell.

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	Machine		Operating System	Memory	Processor		Volume
▪	Host	Platform	Type	Size (MB)	Total Speed (MHz)	Normalized Speed	Used Space (GB)
▫	ACSOURCEW2K3SQL	Virtual	Windows 2003	384.00	3600.00	22.98	0.01 4.55
▪	ADAMW5	Hardware	Windows 2003	3584.00	3990.00	20.63	36.04 2.15 37.24 0.94
▫	AH-W2K3-NFS	Virtual	Windows 2003	256.00	4296.00	9.29	2.25 0.03 1.24
▪	AQIQULH2	VMware Server	Windows 2003	2048.00	3990.00	20.63	
▫	Automation-Host	Virtual	Windows 2003	220.00	2799.00	23.10	11.62 27.53
▪	Blade1-2k	Hardware	Windows 2003	2048.00	4000.00	18.35	16.95 0.14
▫	Blade2-Chas2	Citrix XenServer	Citrix XenServer	4095.35	24000.00	17.26	45.07
▪	CentOS3	Virtual	CentOS Linux	248.18	2931.91	40.17	3.31 0.01
▫	CentOS3.9-64bit	Virtual	CentOS Linux (64 bit)	241.60	2931.69	40.17	2.77 0.02
▪	CentOS4.6-64bit	Virtual	CentOS Linux (64 bit)	245.17	2931.69	40.17	2.96 0.01
▫	CentOS5.1-64bit	Virtual	CentOS Linux (64 bit)	246.75	2931.70	40.17	2.84 0.02
▪	CentOS5.2-64bit	Virtual	CentOS Linux (64 bit)	496.82	2931.61	40.17	2.88 0.02
▫	COMP121	Microsoft Hyper-V	Windows 2008 (64 bit)	4096.00	11996.00	33.84	54.16
▪	comp129	VMware ESX Server	VMware ESX Server	16383.66	26590.00	32.53	1671.09
▫	comp130	VMware ESX Server	VMware ESX Server	16383.66	26590.00	32.53	1294.80
▪	comp131	VMware ESX Server	VMware ESX Server	16379.31	26590.00	32.53	370.75
▫	COMP133	VMware Server	Windows 2003	4096.00	7980.00	18.90	24.54 57.52
▪	COMP134	Microsoft Virtual Server	Windows 2003	4096.00	7980.00	18.90	9.37 20.86

Inventory (Physical & Virtual Machines)

Physical Machines

Powered by PlateSpin. Workload Management from Novell.

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	Machine		Operating System
▪	Host	Platform	Type
−	ADAMW5	Hardware	Windows 2003
−	Blade1-2k	Hardware	Windows 2003
−	COMP139		
−	DEV-ALEKSANDRD3		
−	DEV-ALEXD		
−	DEV-ALEXD2		
−	DEV-ALEXM		
−	DEV-AMNON3		
−	DEV-ANTONF		
−	DEV-ARIELE3		
−	DEV-ARTHURA		
−	DEV-CYRILM3		
−	DEV-DAVIDK		
−	DEV-DAVIDK6		
−	DEV-ELIJ3		
−	DEV-GEORGED2		
−	DEV-HEATHS		
−	DEV-HERBB		
−	DEV-JAMEST3		
−	DEV-JEYS2		
−	DEV-LANCET		
−	DEV-MATTHEWF		
−	DEV-MICHAELDI		
−	DEV-MICHAELP		
−	DEV-MICHAELP2		

Virtual Machines

Powered by PlateSpin. Workload Management from Novell.

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	Machine		Operating System
▪	Host	Platform	Type
−	ACSOURCEW2K3SQL		
−	AH-W2K3-NFS		
−	Automation-Host		
−	CentOS3		
−	CentOS3.9-64bit		
−	CentOS4.6-64bit		
−	CentOS5.1-64bit		
−	CentOS5.2-64bit		
−	CONTINUOUS		
−	dev-petero-sles11-src		
−	DEV-TEST2		
−	DEV-TONYL-XP		
−	DI-Sles10		
−	DI-Sles10		
−	DI-Sles9		
−	di-suse10		
−	dorisiscool		
−	Fedora3		
−	Fedora4		
−	Fedora4-64bit		
−	Fedora5		
−	Fedora5-64bit		
−	Fedora6		
−	Fedora6-64bit		
−	Fedora7	Virtual	Fedora Linux

Utilization Summary

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	Machine		Operating System	Memory		Processor		Disk		Network	
▪	Host	Platform	Type	Pages/sec	Used (%)	Queue Length	Used (%)	MB/sec	IO (%)	MB/sec	Packets/sec
−	DEV-MICHAELDI	Hardware	Windows 2003	5.45	57.32	0.12	3.31	0.12	0.00	0.06	96.40
−	PRO-KENR2	Hardware	Windows XP	52.96	59.81	0.49	16.49	0.42	5.89	0.03	60.03
−	VM-SRC4	Virtual	Windows 2003	43.33	37.84	0.14	4.65	0.18	2.30	0.19	168.40
−	dorisiscool	Virtual	SuSE Linux	–	–	–	–	–	–	–	–
−	SHARONP	Hardware	Windows XP	12.73	51.79	0.02	1.45	0.10	1.15	0.03	55.34
−	WIN2K8STDG	Hardware	Windows 2008	–	–	–	–	–	–	–	–
−	DEV-SMITAG	Hardware	Windows 2003	–	–	–	–	–	–	–	–
−	MH-TRUNK	Virtual	Windows 2003	0.00	27.64	0.01	0.77	0.00	0.20	0.02	37.82
−	DEV-JAMEST3	Hardware	Windows 2003	16.91	73.63	0.21	2.63	0.16	0.00	0.05	78.28
−	DEV-VLADIMIRK2	Hardware	Windows 2003	20.26	64.79	0.15	3.53	0.24	0.00	0.09	127.45
−	Fedora6	Virtual	Fedora Linux	–	25.35	1.61	0.11	0.00	–	0.00	4.27
−	Fedora6-64bit	Virtual	Fedora Linux (64 bit)	–	36.35	1.25	0.16	0.00	–	0.00	12.56
−	Wildfire2	VMware ESX Server	VMware ESX Server	–	74.35	–	3.54	2.26	–	0.63	14568.52
−	DEV-TONYP	VMware GSX Server	Windows 2003	20.63	48.90	0.04	1.54	0.18	1.75	0.04	54.26
−	DEV-LANCET	Hardware	Windows 2003	5.26	73.48	0.25	5.26	0.11	0.00	0.11	175.24
−	COMP121	Microsoft Hyper-V	Windows 2008 (64 bit)	0.02	44.19	0.00	0.25	0.01	0.97	0.05	103.06
−	SCM-CCWINDOWS1	Hardware	Windows 2003	109.22	11.23	0.01	7.47	1.73	0.00	0.69	962.89
−	comp130	VMware ESX Server	VMware ESX Server	–	40.93	–	0.36	1.31	–	0.12	3023.58
−	SRC-JP2K3SP232	Virtual	Windows 2003	0.00	38.72	0.66	0.41	0.00	0.00	0.02	38.07
−	DEV-BENOT2	VMware GSX Server	Windows 2003	19.58	54.71	0.23	6.22	0.16	3.62	0.06	75.17
−	SuSE10-1	Virtual	SuSE Linux	–	9.39	1.02	0.29	0.05	–	0.00	8.99
−	DEV-ALEXANDERN	VMware GSX Server	Windows 2003	27.86	67.18	0.15	3.30	0.28	6.94	0.04	58.64
−	QA-MORTAZA-1	VMware Server	Windows 2003	52.83	42.46	1.09	9.03	0.38	0.00	0.07	87.72
−	comp-sun6.platespin.com	Solaris Zones	Solaris (64 bit)	–	19.65	0.00	2.27	0.05	–	0.00	7.27
−	Solaris-8-SPARC	Hardware	Solaris (64 bit)	–	11.16	0.00	0.10	0.00	–	0.00	3.37

Consolidation Candidates

Poor Consolidation Candidates

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Wednesday, May 13, 2009

	Machine		Operating System	Processor		Memory		Disk	Network
■	Host	Model	Type	Used (%)	Queue Length	Used (%)	Pages/sec	MB/sec	MB/sec
	DEV-MICHAELDI	Precision WorkStation T3400	Windows 2003	3.31	0.12	57.32	5.45	0.12	0.06
	PRO-KENR2	Latitude E6400	Windows XP	16.49	0.49	59.81	52.96	0.42	0.03
	SHARONP	Latitude D630C	Windows XP	1.45	0.02	51.79	12.73	0.10	0.03
	DEV-JAMEST3	Precision WorkStation 390	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-VLADIMIRK2	Precision WorkStation 390	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-LANCET	Precision WorkStation 390	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	PRO-PETERD2	Latitude E6400	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	Fedora7	VMware Virtual Platform	Fedora 7	2.63	0.21	73.63	16.91	0.16	0.05
	FOGBUGZ	VMware Virtual Platform	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	CentOS5.1-64bit	VMware Virtual Platform	CentOS 4/5 (64 bit)	2.63	0.21	73.63	16.91	0.16	0.05
	Blade1-2k	IBM eServer BladeCenter HS20 -[884325U]-	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	MKTG-MIKER	Latitude D630C	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-MICHAELP2	OptiPlex 745	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	Fedora3	VMware Virtual Platform	Fedora 7	2.63	0.21	73.63	16.91	0.16	0.05
	JS-DR-SOURCE	VMware Virtual Platform	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-CYRILM3	Precision WorkStation 390	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-SINISAR3	Precision WorkStation T3400	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-TONYL2	Precision WorkStation 390	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-ALEXD2	Precision WorkStation 390	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-ARTHURA	Precision WorkStation T3400	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	Automation-Host	VMware Virtual Platform	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	IT-WEB1	PowerEdge 1950	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-ALEKSANDRD3	Precision WorkStation 390	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-JEYS2	OptiPlex GX260	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05
	DEV-HEATHS	Latitude D630C	Windows 2003	2.63	0.21	73.63	16.91	0.16	0.05

Good Consolidation Candidates

Powered by PlateSpin. Workload Management from Novell.

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	Machine			Operating System	Processor		Memory		Disk	Network
■	Host	Model	Platform	Type	Used (%)	Queue Length	Used (%)	Pages/sec	MB/sec	MB/sec
	VM-SRC4	VMware Virtual Platform	Virtual	Windows 2003	4.65	0.14	37.84	43.33	0.18	0.19
	MH-TRUNK	VMware Virtual Platform	Virtual	Windows 2003	0.77	0.01	27.64	0.00	0.00	0.02
	SCM-CCWINDOWS1	PowerEdge SC1435	Hardware	Windows 2003	7.47	0.01	11.23	109.22	1.73	0.69
	SRC-JP2K3SP232	VMware Virtual Platform	Virtual	Windows 2003	0.41	0.66	38.72	0.00	0.00	0.02
	ADAMW5	OptiPlex GX620	Hardware	Windows 2003	4.55	0.11	34.35	11.65	0.09	0.05
	INSTALLTEST1	VMware Virtual Platform	Virtual	Windows 2003	4.19	0.75	38.12	77.74	0.48	0.06
	SUPP-DAVIDB	OptiPlex GX620	Hardware	Windows XP	5.19	0.11	48.45	3.82	0.04	0.03
	IT-DC1	PowerEdge 1950	Hardware	Windows 2003	0.37	0.00	23.92	0.17	0.02	0.17
	scm-ccwindows4	VMware Virtual Platform	Virtual	Windows 2003	7.67	0.20	26.53	207.52	2.37	0.09
	AH-W2K3-NFS	HVM domU	Virtual	Windows 2003	1.19	0.00	38.38	3.19	0.04	0.07
	DEV-MATTHEWF	Precision WorkStation 390	Hardware	Windows 2003	3.75	0.14	43.33	34.72	0.35	0.05
	QA-MORTAZA	Dimension 4700	Hardware	Windows 2003	2.03	0.02	39.26	24.27	0.21	0.09
	SRC-FRW2K3SP232	VMware Virtual Platform	Virtual	Windows 2003	0.42	0.25	33.47	0.02	0.00	0.02
	TESTENG	VMware Virtual Platform	Virtual	Windows 2003	1.84	0.44	39.26	0.17	0.01	0.04
	PRO-ORYANA	OptiPlex GX280	Hardware	Windows XP	3.92	0.04	26.87	5.33	0.09	0.05
	IT-CHENB	Latitude D630C	Hardware	Windows XP	15.01	0.48	37.77	21.68	0.27	0.07
	SALES-MARKS	Latitude D620	Hardware	Windows XP	6.70	0.10	46.33	31.80	0.20	0.04
	SCM-CCWINDOWS2	VMware Virtual Platform	Virtual	Windows 2003	17.56	0.33	20.33	375.33	4.79	0.56
	PRO-NICKK	Latitude D620	Hardware	Windows XP	3.55	0.09	30.10	10.13	0.22	0.04
	FIN-ROBBIES	OptiPlex GX620	Hardware	Windows XP	1.21	0.01	39.34	0.03	0.02	0.02
	DEV-ELIJ3	Latitude D620	Hardware	Windows 2003	3.34	0.09	42.75	0.44	0.03	0.04
	PRO-MARIAS2	Latitude D630	Hardware	Windows XP	5.50	0.07	40.69	33.80	0.19	0.03
	RECON-LIQUIDXML	VMware Virtual Platform	Virtual	Windows 2003	3.61	0.01	24.62	0.01	0.00	0.04
	SUPP-IMRANAL	OptiPlex GX280	Hardware	Windows XP	17.49	0.30	45.71	3.02	0.05	0.10
	SCM-PM13	VMware Virtual Platform	Virtual	Windows Vista (64 bit)	1.45	0.03	45.07	13.57	0.05	0.02

Potential Consolidation Candidates

Candidates For Further Analysis

Powered by PlateSpin. Workload Management from Novell.

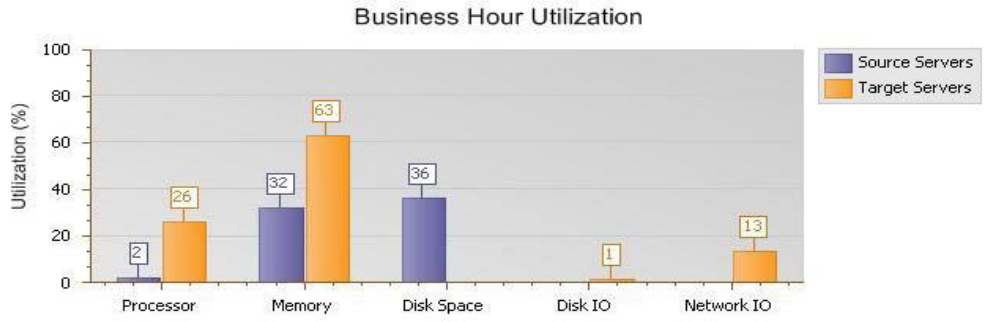
Wednesday, May 13, 2009

	Machine		Operating System	Processor	Memory	Disk	Network	Volume
▪	Host	Platform	Type	Used (%)	Used (%)	IO (%)	MB/sec	Free Space (GB)
–	ADAMW5	Hardware	Windows 2003	4.55	34.35	1.08	0.05	42.72 47.43 12.56 53.74
–	AH-W2K3-NFS	Virtual	Windows 2003	1.19	38.38	0.00	0.07	0.58 1.00 296.76
–	COMP139	Hardware	Windows 2003	0.05	16.65	0.00	0.04	44.22 1197.76
–	DEV-ALEXD	Hardware	Windows 2008 (64 bit)	--	--	--	--	38.78 21.36
–	DEV-ANTONF	Hardware	Windows 2003	4.00	45.68	0.00	0.05	40.13 26.75
–	DEV-DAVIDK6	Hardware	Windows Vista	--	--	--	--	1.40 16.24 39.14
–	DEV-HERBB	Hardware	Windows 2003	0.48	37.20	0.00	0.05	1.41 2.06 40.99
–	DEV-NADERS3	Hardware	Windows 2003	1.56	46.52	0.00	0.07	28.51 15.58 215.49
–	DEV-PASCALV3	Hardware	Windows 2003	1.91	32.90	0.00	0.06	42.12 51.92 465.32
–	DEV-SMITAG	Hardware	Windows 2003	--	--	--	--	1.40 35.68 22.03
–	DOCS	Hardware	Windows XP	0.65	29.80	17.91	0.04	51.97 151.56
–	FIN-ROBBIES	Hardware	Windows XP	1.21	39.34	16.52	0.02	56.74
–	GL-IMGSVRVIS	Hardware	Windows Vista	--	--	--	--	0.99 190.82
–	IT-CHENB	Hardware	Windows XP	15.01	37.77	3.47	0.07	36.95
–	IT-DC1	Hardware	Windows 2003	0.37	23.92	2.55	0.17	92.44 142.00 35.78

Virtualization Report

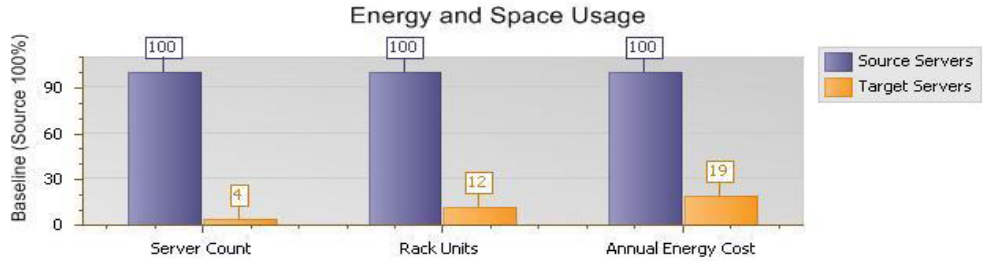
Scenario Summary: new

Wednesday, November 05, 2008



Summary	
New Servers	7
Forecast	None
Consolidation Ratio	21.1:1
TCO	0

Workloads	
Consolidated	148
Unconsolidated	0
Total	148



	Server Count	Rack Units	Annual Energy Cost	Energy Use (kWh/yr)	Heat Dissipation (BTU/yr)	Processor (%)	Memory (%)	Disk Space (%)
Source Servers	148	218	41059.22	273728.1	933250980	2.2	32.4	36.4
Target Servers	7	28	8002.26	53348.4	181918044	25.9	62.8	
Change	-141	-190	-33056.96	-220379.7	-751332936	23.6	30.3	
Change (%)	-95.3	-87.2	-80.5	-80.5	-80.5	1059.1	93.4	

Disk Utilization Report

Disk Utilization

- The overall average storage utilization across all servers is 35.67%. The highest utilization is at 72.83% while the lowest utilization is at 2.91%.

Top N Servers Based on Percentage of Capacity Used

(Any activity within the last 20 minutes may not be included.)

Rank	Server Name	Used Space (GB)	Capacity (GB	% Used Capacity
1	FILESERVER	83.05	114.04	72.83 %
2	CADSERVER2	21.90	37.21	58.86 %
3	CADSERVER1	21.44	37.21	57.60 %
4	SUN-DEMO-02	25.68	46.05	55.77 %
5	linuxserver	98.80	373.71	26.44 %
6	BIGNAS	3.32	114.04	2.91 %

Figure 1: Servers percentage capacity used

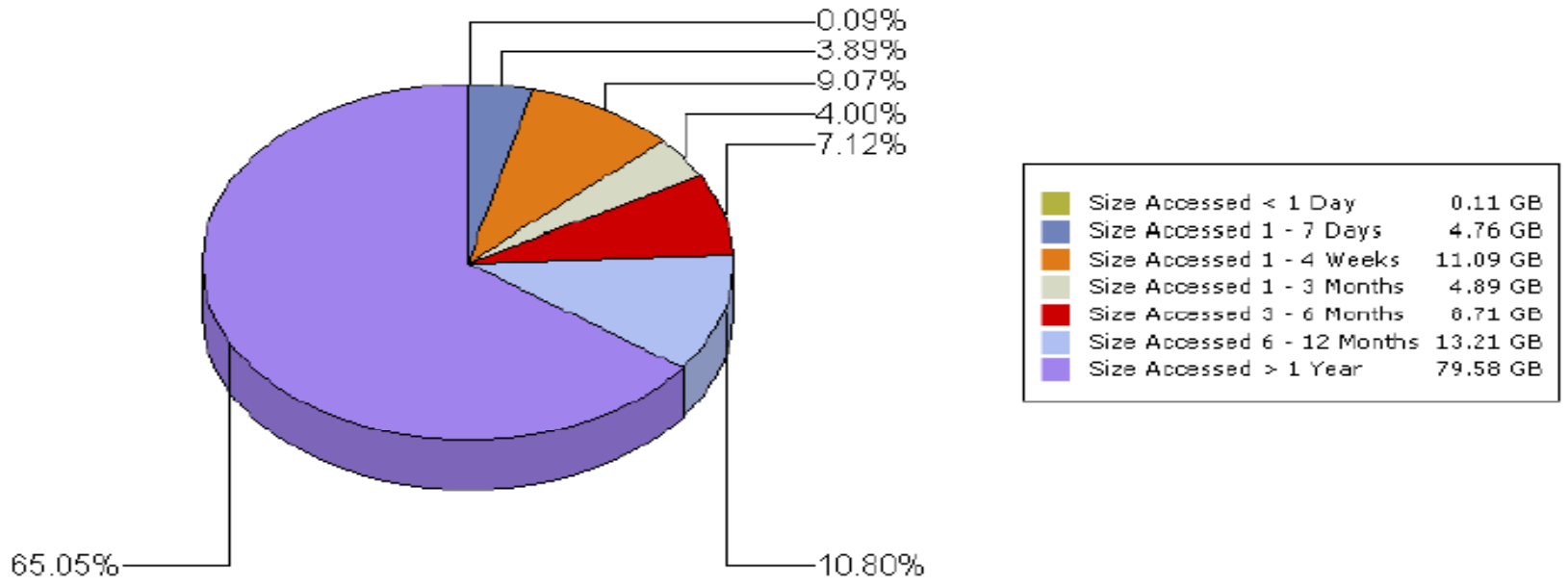
- The highest utilized volumes are at 73.00%. These volumes will soon need to have capacity added and are also candidates for active archiving.

File Age Distribution Report

- Overall, 75.85% of the files currently residing on Acme Corporation's tier 1 storage have not been accessed in the last 6 months. Depending on the utilization patterns of this data, it may be possible to archive this data onto a Hitachi Content Archive Platform.
- 65.05% of files have not been accessed in over 1 year.
- 10.80% of files have not been accessed in the last 6 – 12 months.
- 7.12% of files have not been accessed in the last 3 – 6 months.

File Age Distribution showing Size of Files based on Last Access Time

CAD Servers



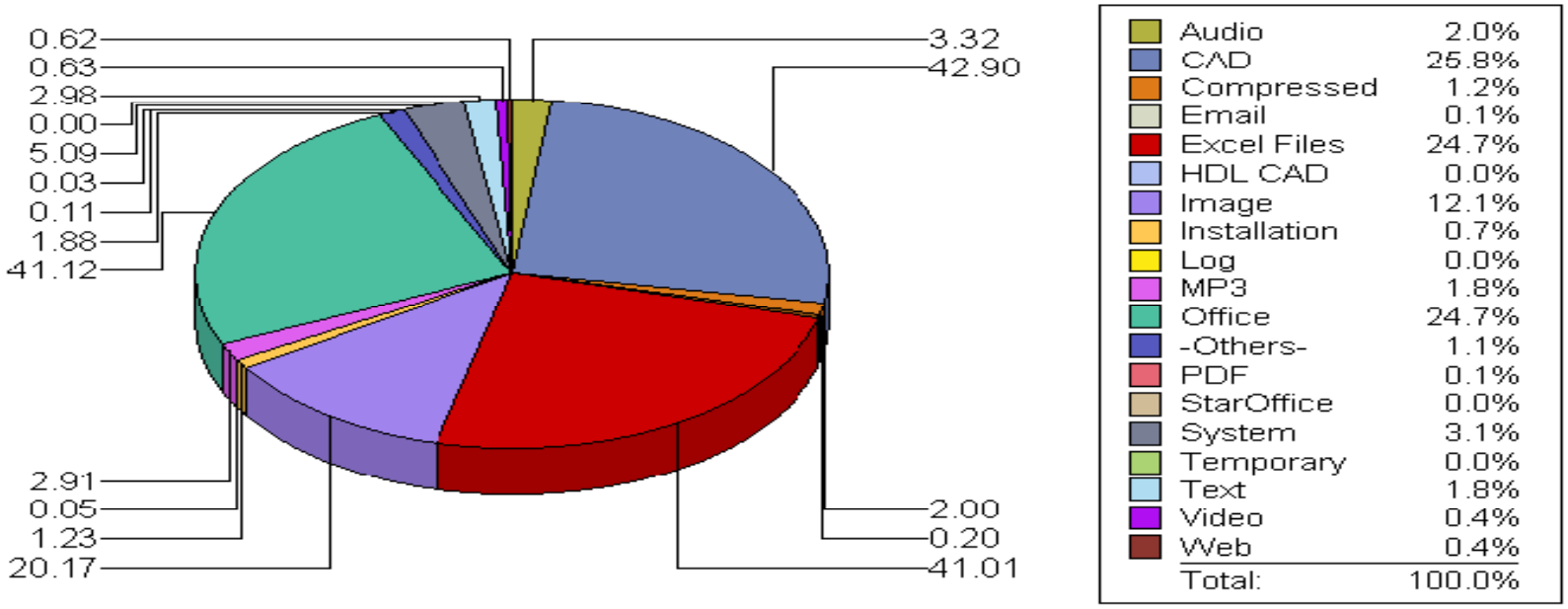
Space Consumption by File

- The following chart shows the quantity of space consumed by various file types. This break down can be useful in ensuring the proper files are located on the appropriate storage. It can also be used for the identification and deletion of inappropriate files.
- 25.8% of the storage environment is comprised of CAD files.
- 24.7% of the storage environment is comprised of Office files.
- 24.7% of the storage environment is comprised of Excel files.

Space Consumption Grouped By File Type

Entire System

(File size shown in GB)



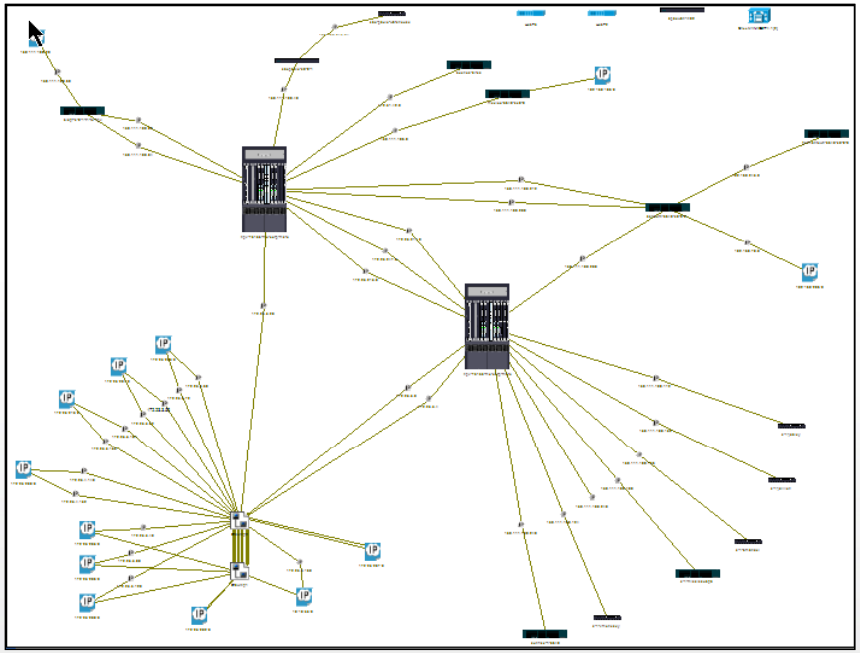
Additional Assessment Reports

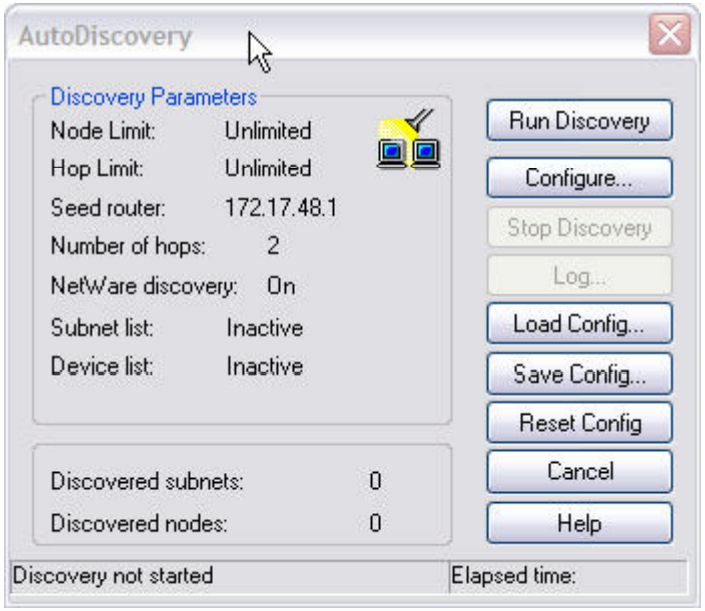
- Capacity:
  - System-wide
  - By Volume / Server
  - File Age Distribution
  - By File Types
  - By Largest Consumers
- Resource Usage:
  - Space Consumption
  - Volume Group Space Consumption
  - Space Consumption Trends
  - Volume Group Space Consumption Trends
  - Top N Space Consumption
  - Top N Capacity Consumption
- Data Usage
  - File Age Distribution
  - File Age Distribution Trends
  - Stale File Analysis
- Capacity Planning
  - Space Consumption Trends
  - File Age Distribution Trends
- Availability
  - Server Agent Availability Status
  - Server Agent Availability Status Trends
- Operations
  - Migration & Recall Trends
  - Operation Success/Failure Trends
- Policy Monitoring
  - Data Migration Distribution
  - Policy Results
  - Policy Results – Cost Savings
  - Copy Action Distribution
  - Move Action Distribution
  - Delete Action Distribution
  - Move Action History
  - Copy Action History
  - Delete Action History

Network Auto Discovery

Network Assessment is a key step in the Data Center Assessment

- Network Assessment & Analysis
- Configuration, Design, Validation





- **Base-Line the Topology and Technology of a Customers' Network**
- **Analyze discovery to propose:**
  - Upgrades
  - Replacements
  - Maintenances

Network Audit and Discovery

Device Information Retrieved :

- Serial and catalog number
- Addresses:
  - IP (Inactive & Active)
  - IPX
  - MAC (Inactive & Active)
- Free and used device memory
- Hardware and software (IOS) versions
- Device internal configuration including card positions
- Host and system names
- Configuration files
- Physical connections between devices
- Device status (EoL, EoS, etc.)

Project Name: AD2
Created On: 8 May 2006

Name	IP Address	MAC Address	Category	Last Discovered	First Discovered
apacwan-in02	192.168.159.94	0004c1364520	Routers	Jun 16, 2004	AutoDiscovery (Jun 16, 2004)
ashburn-3640-s0-0-0	192.168.245.10, 138.111.199.209, 138.111.199.213, 138.111.199.202, 192.168.70.253	00107ba7bad0	Routers	Jun 16, 2004	AutoDiscovery (Jun 16, 2004)
bldgf-s-0-1-t1-to-npv	138.111.199.70, 138.111.199.85, 138.111.199.61	00107bcae831	Routers	Jun 16, 2004	AutoDiscovery (Jun 16, 2004)
buenos-aires	192.168.104.254, 172.31.42.253	5073605241	Routers	Jun 16, 2004	AutoDiscovery (Jun 16, 2004)
germantown-3640-s0-0-0	192.168.27.254, 192.168.245.9	00107ba3d590	Routers	Jun 16, 2004	AutoDiscovery (Jun 16, 2004)
mexico-3640-se0-0	138.111.196.9, 192.168.106.253	00107ba45230	Routers	Jun 16, 2004	AutoDiscovery (Jun 16, 2004)
npv-7513a-mc-corp-msfc	172.23.5.9, 138.111.199.110, 138.111.199.114, 138.111.199.126, 138.111.199.134,	00046d489080, 00046d489120, 00046d489100, 00046d4890a0	Routers	Jun 16, 2004	AutoDiscovery (Jun 16, 2004)

Link Name	Protocol	VLAN	Source Device	Source Port	Destination Device	Destination Port
1000BaseT	1000BaseT	Accounting-ELAN Marketing-ELAN Sales-ELAN	Ethernet Routing Switch 5520-48T-PWR	Port 8	Threat Protection System Defense Center 2070	Port 1
100BaseT	100BaseT	Accounting-ELAN Marketing-ELAN Sales-ELAN	PC	Port 1	BayStack 450-24T Switch, North American Power Cord	Port 4
100BaseT	100BaseT	Accounting-ELAN Marketing-ELAN Sales-ELAN	PC	Port 1	BayStack 450-24T Switch, North American Power Cord	Port 3
100BaseT	100BaseT	Marketing-ELAN	PC	Port 1	BayStack 450-24T Switch, North American Power Cord	Port 2
100BaseT	100BaseT	Marketing-ELAN	PC	Port 1	BayStack 450-24T Switch, North American Power Cord	Port 1
100BaseT	100BaseT	Marketing-ELAN	PC	Port 1	BayStack 450-24T Switch, North American Power Cord	Port 8

Enterprise AutoDiscovery Reports

Newly Discovered Devices and Components
Old Devices that were Missing in this Discovery
All Project Devices

ProjectName: Project1
Created On: Dec 2005

Name	IP Address	MAC Address	IPX Address	Category	Last Discovered	First Discovered
compsvr1	172.26.4.70	000629a852a9		PCservers	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
compsvr4	172.26.4.66	0050dad8331b		Servers	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
dot-net-srv	172.26.4.26	00112ff451bf		PCservers	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
eyal	172.26.4.102	000ea6b84a75		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
ilana	172.26.4.45	0011d818a3f3		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
Imagenet.inter.net.il	172.26.4.201	00000c4a6de6		Routers	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
itaish	172.26.4.74	005004bfaa34		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
lironl1	172.26.4.85	0011d818a3eb		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
liron	172.26.4.114	0003470ac9be		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
netformx.inter.net.il	172.26.4.200	0030195289a0		Routers	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
nirg2	172.26.4.41	0050dac682c6		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
outsource	172.26.4.56	0003470ac9b8		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
panagon	172.26.4.79	0001021db3f0		PCservers	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
qa13	172.26.4.77	0050da829a97		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
ronen	172.26.4.96	0050da829c23		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
tamir	172.26.4.88	005004a5e8ca		Workstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
vpc2-dev-evgeni	172.26.4.47	0003ff67d0c5		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
xrx0000f0a388cc	172.26.4.15	020000000000, 0000f0a388cc		Workstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)
yvgenyc	172.26.4.37	00112ff44ca2		PCstations	Dec 19, 2005	AutoDiscovery (Dec 19, 2005)

Network Auto Discovery Reports

Equipment Summary report

- Vendor info
- IOS version

Device Name	IP Address	Vendor	System Name	System Description	IOS	Part Number	Used Memory (RAM)	Free Memory Size (RAM)	Flash Memory Size	Flash Memory Free
Netformx HP-2524	192.168.x.x	Hewlett Packard	Netformx HP-2524	HP J4813A ProCurve Switch 2524, revision F.05.34, ROM F.01.01 (/sw/code/build/info(s02))		J481xx				

Interface Type	Interface Speed (bps)	Interface Count
ethernet-csmacd(6)	100000000	7
ethernet-csmacd(6)	10000000	18
ethernet-csmacd(6)	1000000000	1
propVirtual(53)	0	1
softwareLoopback(24)	0	1

Device Name	IP Address	Vendor	System Name	System Description	IOS	Part Number	Used Memory (RAM)	Free Memory Size (RAM)	Flash Memory Size	Flash Memory Free
vlan16	192.168.x.x, 192.168.x.x, 192.168.x.x,192.168.x.x, 192.168.x.x, 192.168.x.x,192.168.x.x, 192.168.x.x, 192.168.x.x.192.168.x.x.	cisco	RMED-1.cisco-irn.com	Cisco IOS Software, 3800 Software (C3825-ADVIPSERVICESK9-M), Version 12.4(9)T, RELEASE SOFTWARE (fc1)Technical Support: http://www.cisco.com/techsupportCopyright (c) 1986-2006 by Cisco Systems, Inc.Compiled Fri 16-Jun-06 22:03 by prod_rel_team	12.4(9)T	CISCO3825	20140 bytes	491512 bytes	128180224	54251520

Product Availability Report

- End of Life
- End of Support, etc.

Instance Name	Part Number	Description	Qty	Lead time	End of Engineering Support Date	End of Life Announcement Date	End of New Service Attachment Date	End of Routine Failure Analysis Date	End of Sale Date	End of Service Contract Renewal Date	End of Software Maintenance Releases Date	Last Date of Support
MCS-7815I-3.0-IPC1	MCS-7815I-3.0-IPC1	HW Only MCS-7815I-3000 with P4 3.06, 1024MB RAM, 80GB HD	1		16-FEB-2007	16-NOV-2004	16-FEB-2006	16-FEB-2006	16-FEB-2005	16-NOV-2009	16-FEB-2006	16-FEB-2010
CAB-AC[2]	CAB-AC	Power Cord,110V	2	14 Days								
MCS-7815I-3.0-IPC1	MCS-7815I-3.0-IPC1	HW Only MCS-7815I-3000 with P4 3.06, 1024MB RAM, 80GB HD	1		16-FEB-2007	16-NOV-2004	16-FEB-2006	16-FEB-2006	16-FEB-2005	16-NOV-2009	16-FEB-2006	16-FEB-2010
CAB-AC[2]	CAB-AC	Power Cord,110V	2	14 Days								
MCS-7815I-3.0-IPC1	MCS-7815I-3.0-IPC1	HW Only MCS-7815I-3000 with P4 3.06, 1024MB RAM, 80GB HD	1		16-FEB-2007	16-NOV-2004	16-FEB-2006	16-FEB-2006	16-FEB-2005	16-NOV-2009	16-FEB-2006	16-FEB-2010
CAB-AC[2]	CAB-AC	Power Cord,110V	2	14 Days								
MCS-7815I-3.0-IPC1	MCS-7815I-3.0-IPC1	HW Only MCS-7815I-3000 with P4 3.06, 1024MB RAM, 80GB HD	1		16-FEB-2007	16-NOV-2004	16-FEB-2006	16-FEB-2006	16-FEB-2005	16-NOV-2009	16-FEB-2006	16-FEB-2010

Network Auto Discovery Reports

Based on Discovered IP Network and Addressing Scheme User May Design New Components and Addresses in a Validated Environment

Ability To Generate Physical Connections Report

AutoDiscovery Physical Connections Report

Device Name	Interface Number	Interface Name	Connected To Device	Connected Interface Number	Connected Interface Name	Link Speed(Kbps)	Link Type
172.26.1.200	1	BayStack - module 1, port 1	pc58.imagenet.co.il	Undefined		200000000	ethernet-csmacd(6)
172.26.1.200	2	BayStack - module 1, port 2	imagedc01.imagenet.co.il	Undefined		200000000	ethernet-csmacd(6)
172.26.1.200	3	BayStack - module 1, port 3	liron	Undefined		200000000	ethernet-csmacd(6)
172.26.1.200	4	BayStack - module 1, port 4	compsvr1	Undefined		200000000	ethernet-csmacd(6)
172.26.1.200	5	BayStack - module 1, port 5	imagedc02.imagenet.co.il	Undefined		200000000	ethernet-csmacd(6)
172.26.1.200	6	BayStack - module 1, port 6	lina2	Undefined		200000000	ethernet-csmacd(6)
172.26.1.200	7	BayStack - module 1, port 7	ronenk	Undefined		200000000	ethernet-csmacd(6)

Ability to Create a Inventory Reports Including Serial Numbers

Name	Catalog Num	Description	Serial Number	Qty
Cisco Systems Inc.				
Imagenet.inter.net.il	CISCO2501-DC	Cisco 2501 Ethernet/Dual Serial Router-DC	2416373	1
SF25C-11.1.3	Gen-TCP/IP-sw	Gen-TCP/IP-SW		1
netformx.inter.net.il	CISCO2620	10/100 Ethernet Router w/2 WIC Slots, 1 Network Module Slot	JAB034102TJ (2534112750)	1
C2600-I-M, Vers 12.0(3)T3	Gen-TCP/IP-sw	Gen-TCP/IP-SW		1
WIC-1T	WIC-1T	1-Port Serial WAN Interface Card	0	1
WIC-1T	WIC-1T	1-Port Serial WAN Interface Card	0	1

Software Asset Assessment

Page 2 of 6 — Site Software Assets

Software

Operating System Inventory

Operating System	Count
Microsoft Windows XP Professional	1
Microsoft(R) Windows(R) Server 2003 for Small Business Server	1
Microsoft(R) Windows(R) Server 2003, Standard Edition	1
Microsoft(R) Windows(R) Server 2003, Web Edition	1
Microsoft® Windows Vista™ Business	1
Microsoft(R) Windows(R) Server 2003, Enterprise Edition	3
Total	**8**

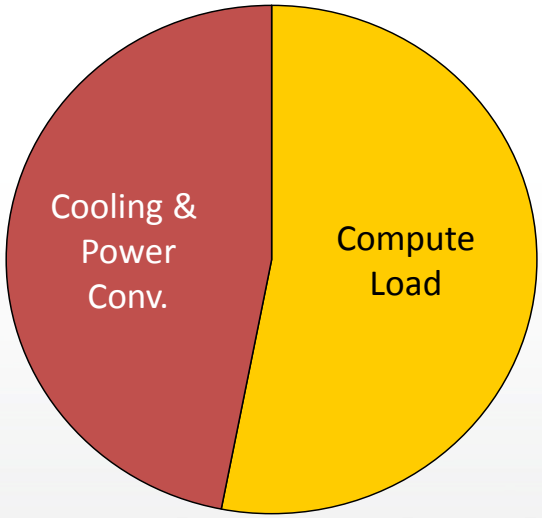
Software Inventory

Application	Count
Acronis Backup Server	1
Acronis True Image Enterprise Server	1
Acronis True Image Server	3
Adobe Flash Player 9 ActiveX	4
Adobe Flash Player ActiveX	1
Adobe Reader 7.0.9	1
Adobe Reader 8	2
ATI - Software Uninstall Utility	1
ATI Control Panel	1
ATI Display Driver	1
ATI HydraVision	1
Camtasia Studio 4	1
DFE-538TX	1
GDR 1406 for SQL Server Database Services 2005 ENU (KB932557)	1
GDR 1406 for SQL Server Integration Services 2005 ENU (KB932557)	1
GDR 1406 for SQL Server Reporting Services 2005 ENU (KB932557)	1
GDR 1406 for SQL Server Tools and Workstation Components 2005 ENU (KB932557)	1
Intel(R) Graphics Media Accelerator Driver	1
Intel(R) PRO Network Connections	1
Intel(R) PRO Network Connections 11.2.0.69	1
iReasoning MIB Browser (remove only)	2
LiveUpdate 3.2 (Symantec Corporation)	1
Managed Workplace Onsite Manager	6
Managed Workplace Service Center	2

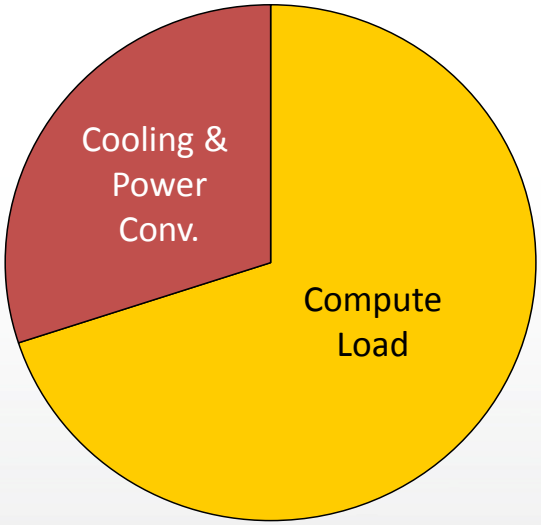
- **Complete list of all applications, software licenses, patches applied to each system**
- **Software audits to identify all approved and unauthorized software packages**
- **Complete and detailed inventory of all OS' systems**

Energy Efficiency Measures

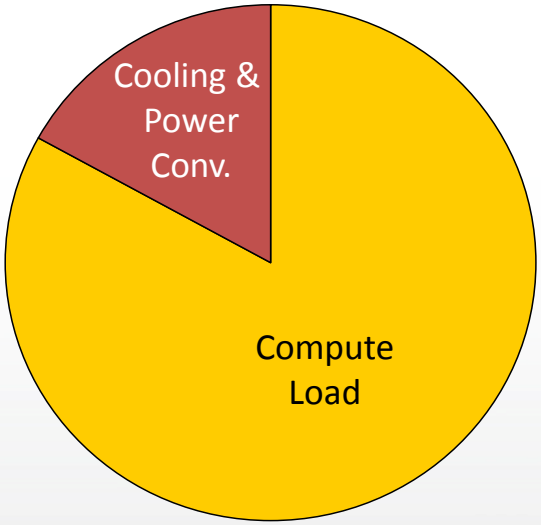
$$PUE = \frac{\text{Total Data Center Power Consumption}}{\text{IT Power Consumption}}$$



Current trend (1.9)

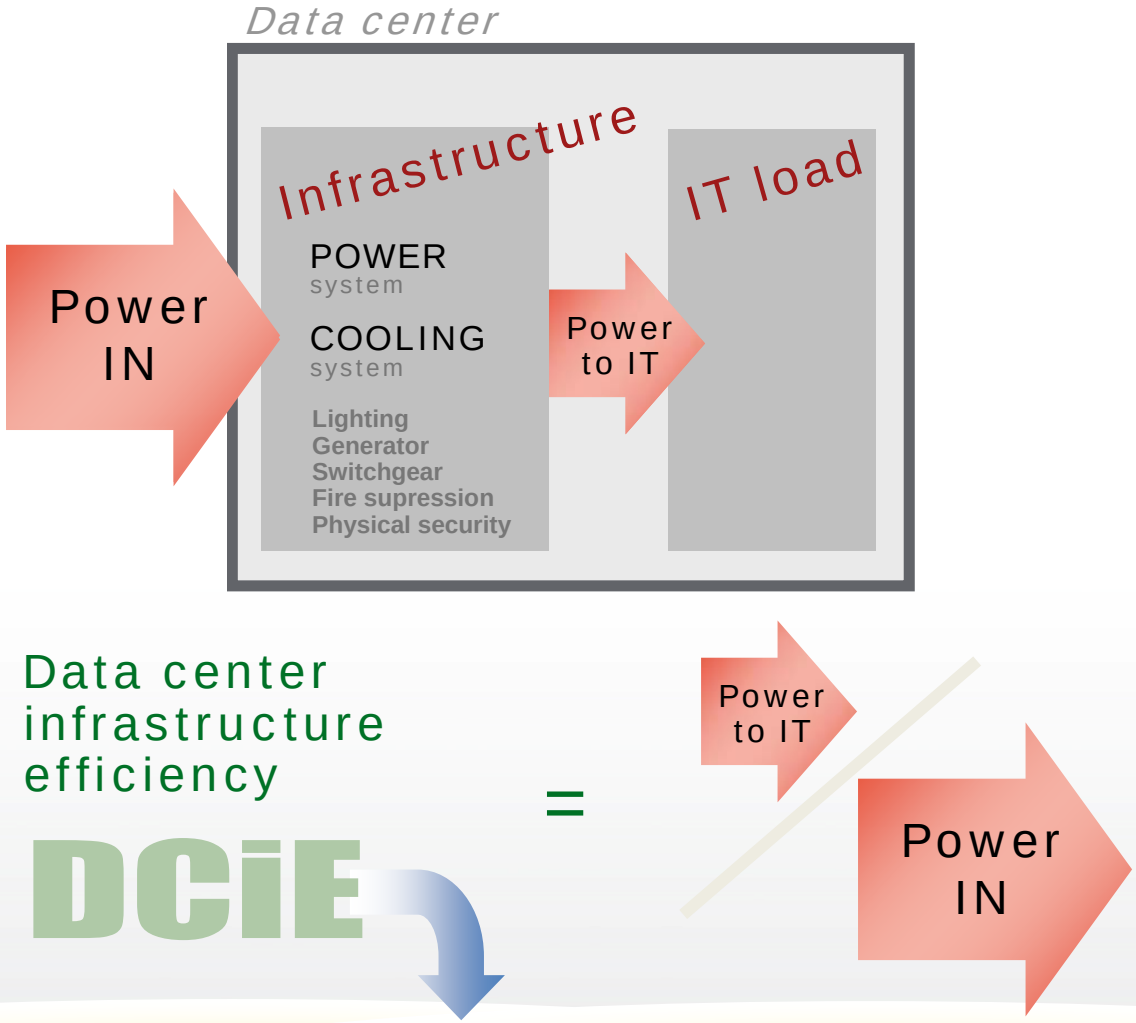


Best practices (1.4)



State of the art (1.2)

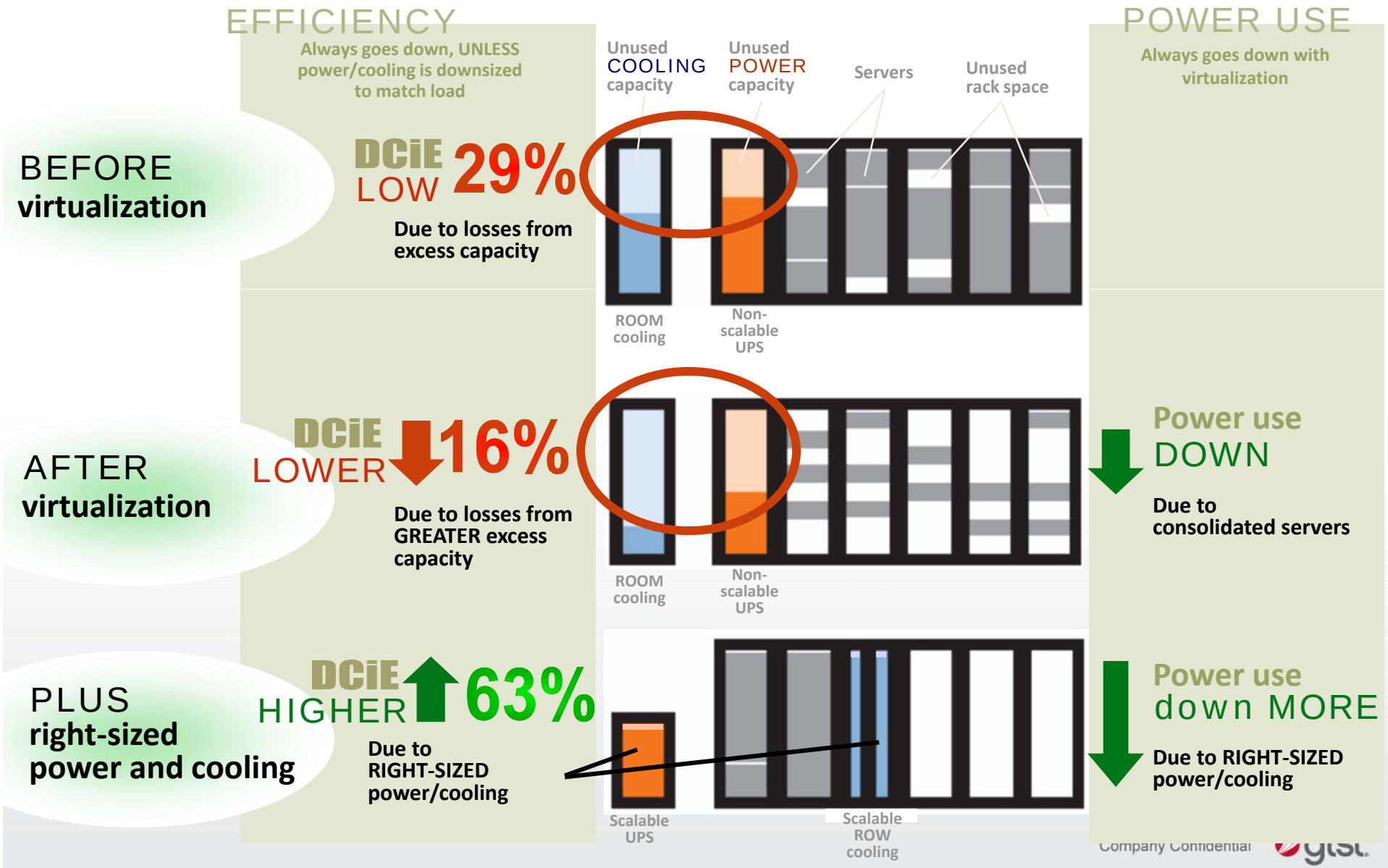
What is “data center efficiency”?



The percent of your input power that gets to the IT loads

The rest is consumed by the power system, the cooling system, and other elements of data center infrastructure

Right-sizing improves power use AND efficiency



Energy Efficiency Metrics (PUE & DCiE)

- $PUE = \frac{\text{Total Power}}{\text{Useful Power}}$
- DCiE = 1/PUE
  - PUE = power utilization efficiency
  - Total power includes power distribution, cooling, fans, lighting, UPS and equipment
  - Useful power is IT equipment only

PUE	DCiE	Comment
1.3	77%	Optimized design
1.6	62.5%	Best practices
2.0	50%	Some opportunity
3.0	33%	Unmanaged

Source: Gartner estimates based on client discussions

While PUE is not the perfect measurement, use it to identify current status and improvements made

Technology improvements that lower the total power, such as better power efficiency and better cooling efficiency, will show up in a lower PUE

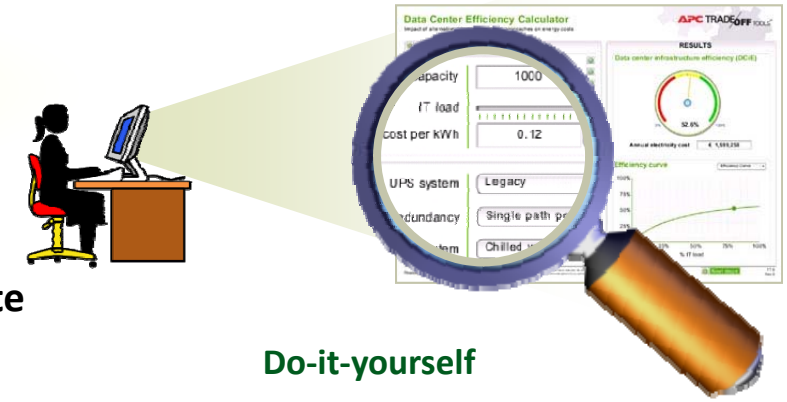
PUE has complex interactions – for example, if you raise the temperature of the data center you can lower cooling cost but increase power cost more as server fans ramp up (cube law). PUE would go down as total power goes down or stays same but useful (?) power goes up because of server fans.

Finding out your efficiency

1 Rough idea

Interactive efficiency tool

- **Work on your own**
- **Adjust model parameters to approximate your data center**
- **View efficiency curve, electric bill, and power/cooling/IT breakdown**



Do-it-yourself

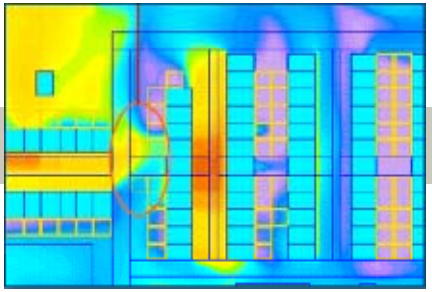
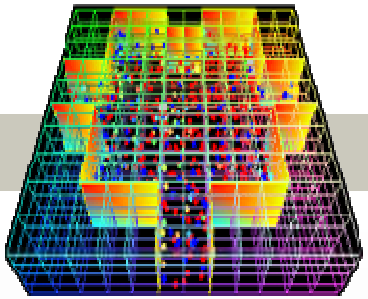
2 Specific to your data center

Efficiency assessment service

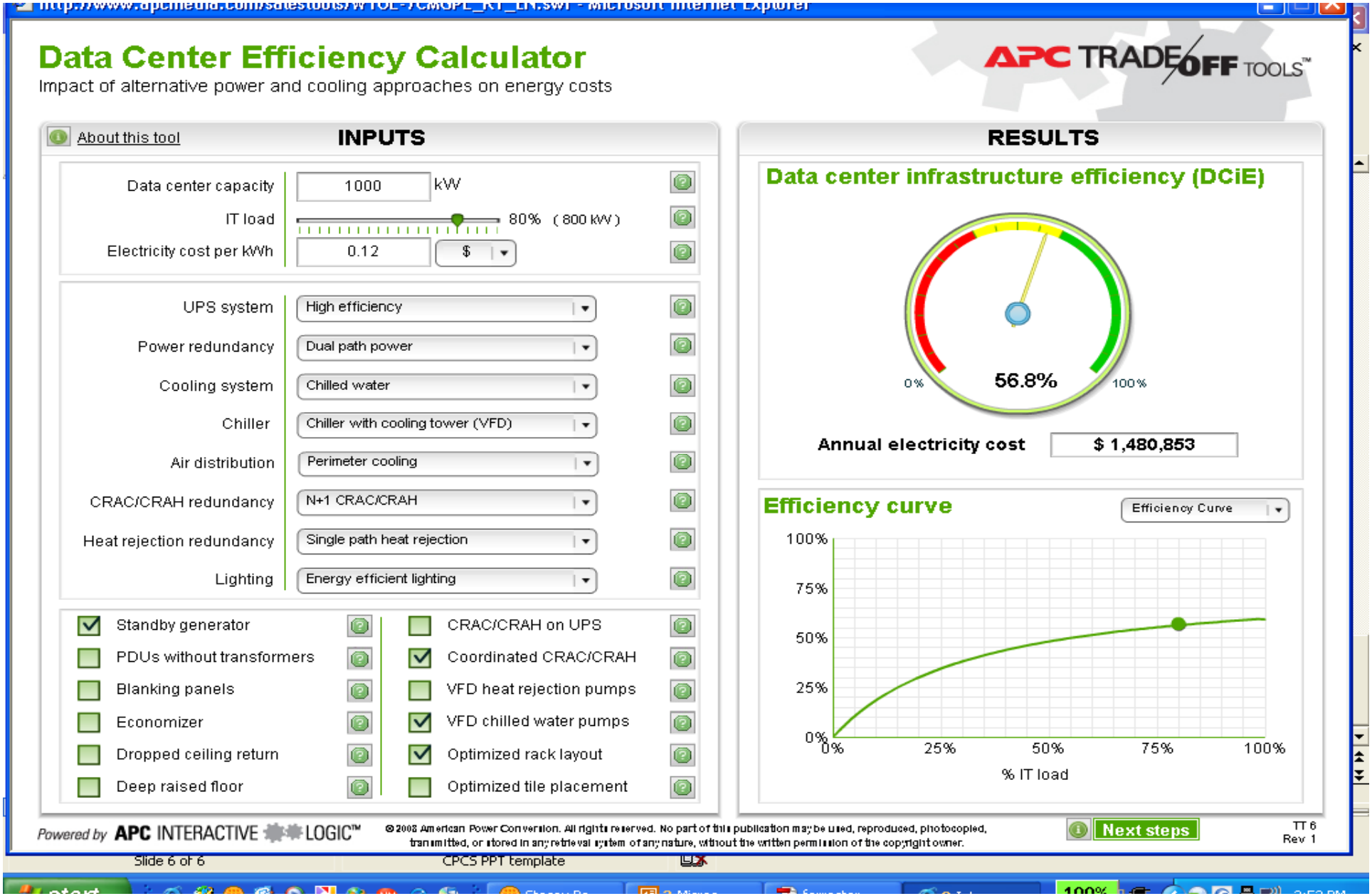
- **On-site measurement**
- **Model parameters calibrated to your data center**
- **Interactive tool will now model YOUR data center**

Professional

Power and cooling assessments

Thermal Quick Assessment	Thermal Intermediate Assessment	Thermal Comprehensive Assessment
		
• Visual inspection • Data measurements • Basic report and recommendations	• Data gathering above floor modeling • Thermal modeling • Extensive report and recommendations	• 3D under- and above-floor modeling • Thermal prediction • Comprehensive report and recommendations

Data Center Efficiency Calculator



GTSI Green IT Calculator

gtsi. One Mission. Yours.

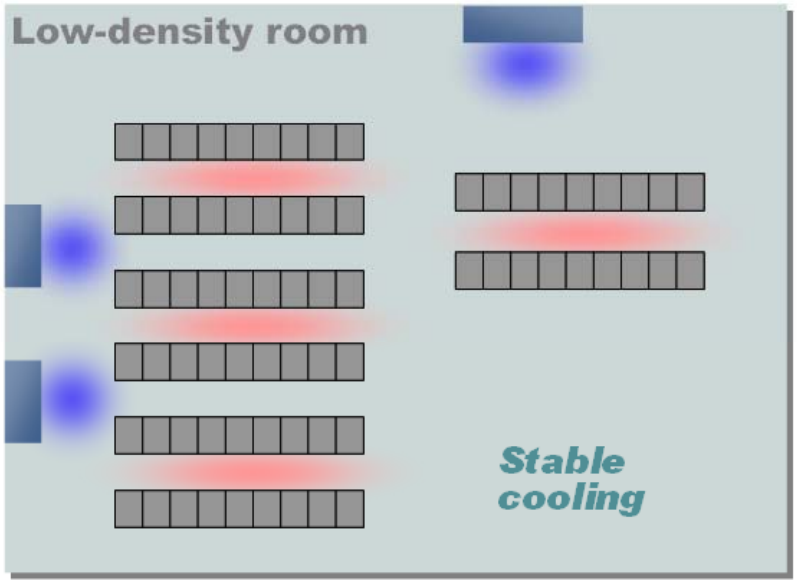
GTSI Go Green Calculator

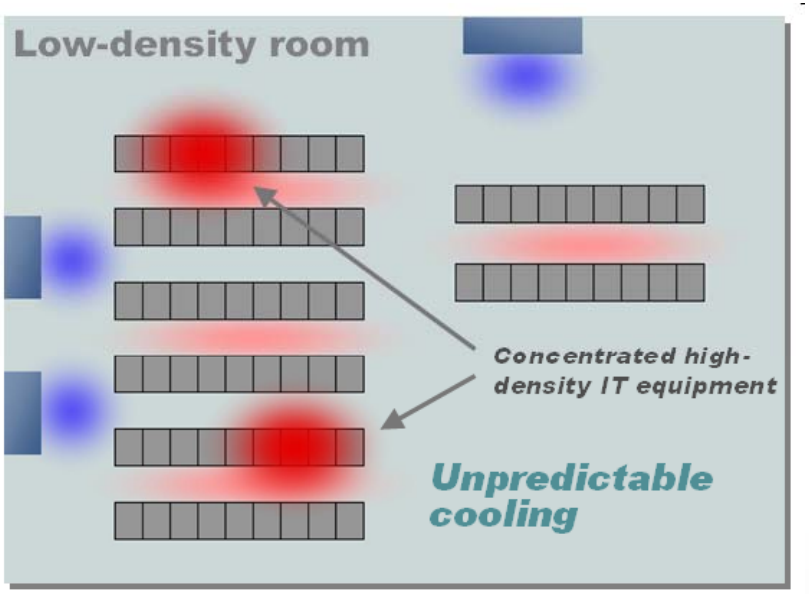
Virtualization Calculator: Data Entry

Please enter the number of servers you would like to consolidate using virtualization in the fields below, as well as hours of peak operations, cost per KwH, and average server growth rate (%). If this information is not available, industry averages from IDC have been provided. Once you are complete, click the submit button to view your year one (1) results.

	Number of Servers:	Average Server Utilization % (usually 5 - 10%):
1U	10	5
2U	10	5
4U	10	5
8U	500	5
16U	10	5
Data Center Hours Per Day		24
Number of Peak Hours		12
Cost Per KwH (IDC Average Default)		.11
Average Growth Rate Per Year (%) (IDC Average Default)		15 %
Select from the drop down the level of utilization you would like your servers to perform at:		50%
		submit

PROBLEM:
Unmanaged high density





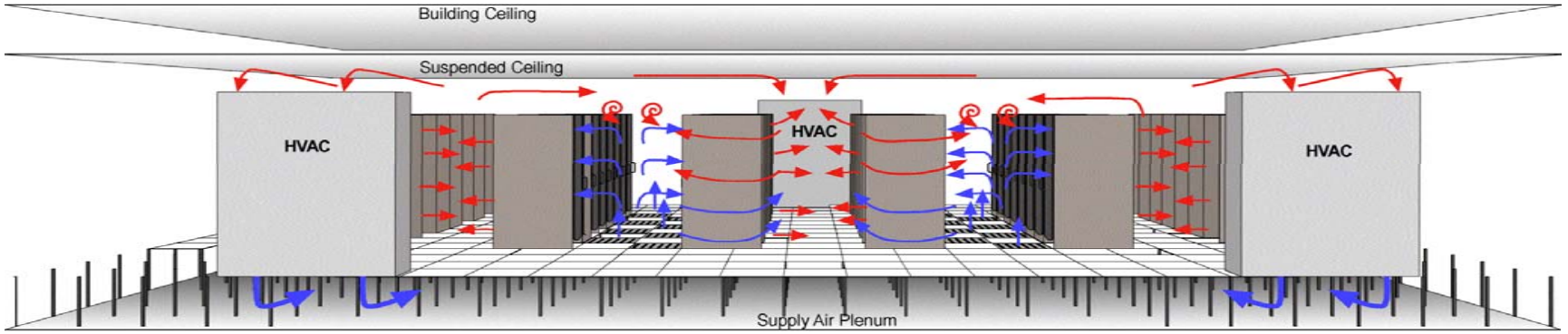
Low-density data center

- Room-based cooling
- Raised floor distributes cooling
- Cooling is stable

High-density hot spots

- Unpredictable cooling & moving hot spots
- Loss of cooling redundancy
- Risk of unplanned downtime from thermal overload
- Where to put the next new server?
- Expense/delay of cooling assessment

Best practice: Data Center Airflow



40-50% of the inefficiency inside datacenter is linked to lack of best practices deployment

Best practices

- Hot aisle/cold aisle
- Matching server airflows
- Eliminate gaps in rows
- Use longer rows
- Use cabinet blanking panels
- Orient AC units perpendicular to hot aisles
- Seal cable cutouts
- Use 0.8m to 1.0m high floors
- Use high and low density areas
- ITSM

Benefits

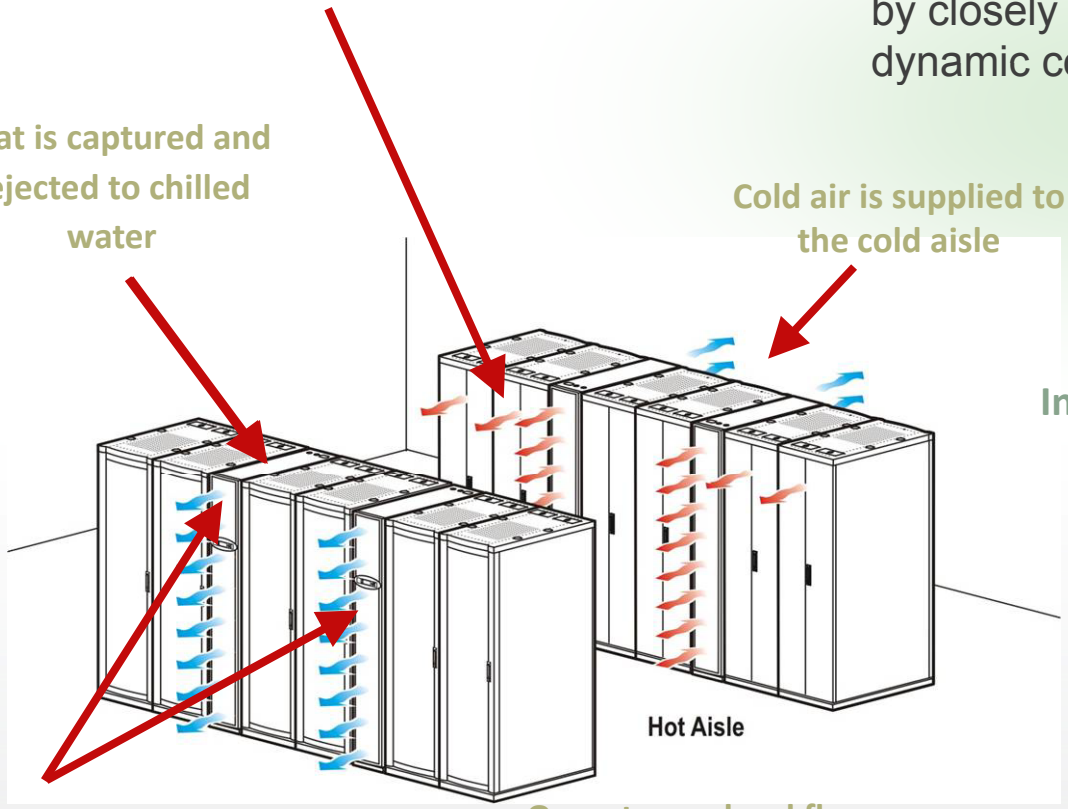
- Lower server temperatures
- Better reliability
- Better uptime
- Extends life of current data center
- Maximize server density
- Lower energy usage
- Lower TCO

Cooling IN the row, close to the load

Hot-aisle air enters from rear, preventing mixing of hot and cool air

Heat is captured and rejected to chilled water

Cold air is supplied to the cold aisle

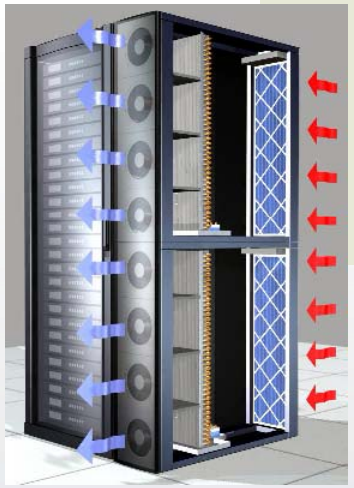


Operates on hard floor or raised floor

InRow® units

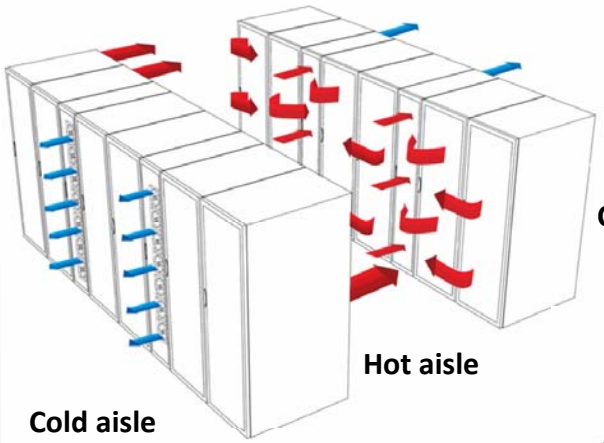
Variable-speed fans optimize efficiency by closely matching performance to dynamic cooling demand

InRow® cooling units

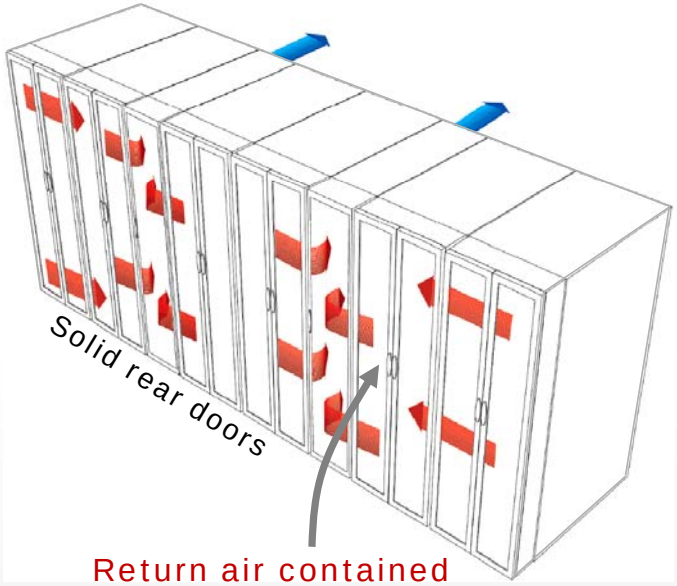


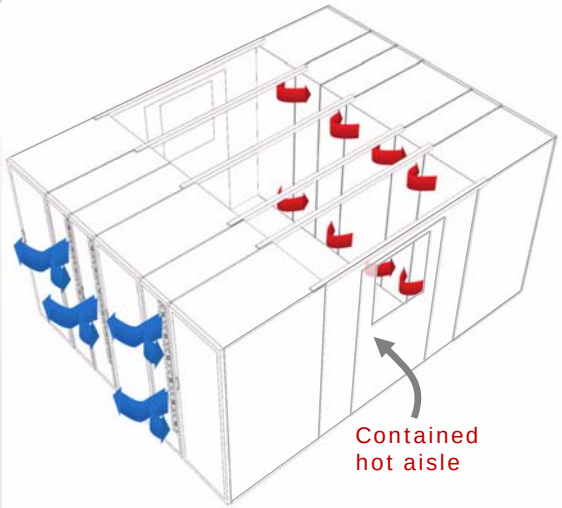
Zone technologies for Power & Cooling

NO containment



REAR containment

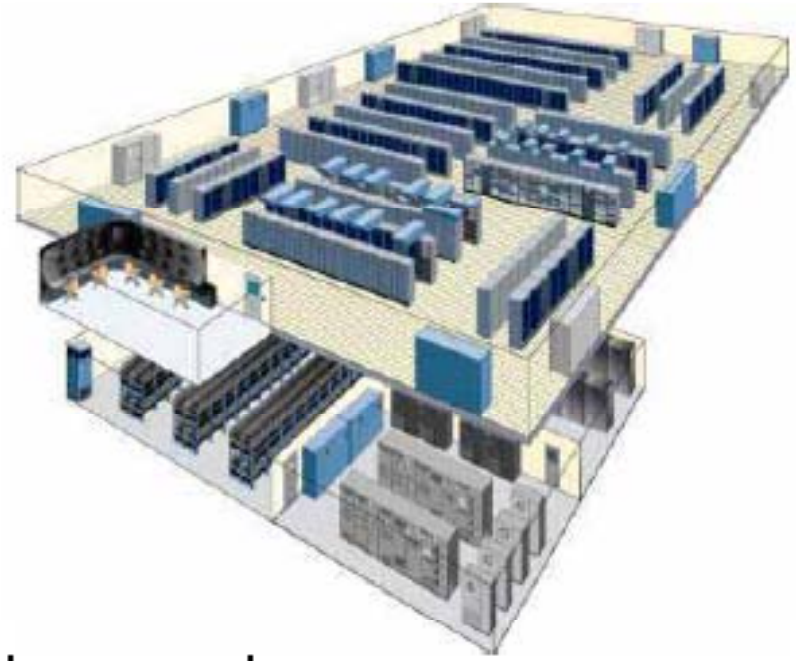




HOT-AISLE containment

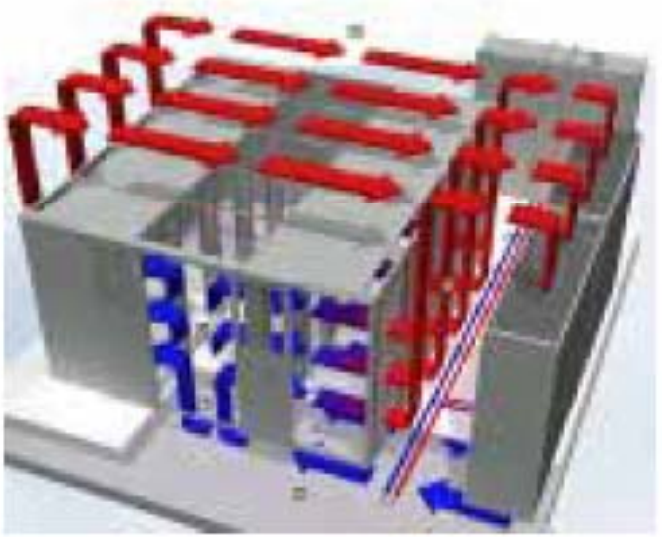
Contained Air Flow

Open uses open racks and processes all the air in the room



- Less complex
- Does not limit rack selection
- Scale up difficult, scale out easy

Contained controls flow for optimal efficiency



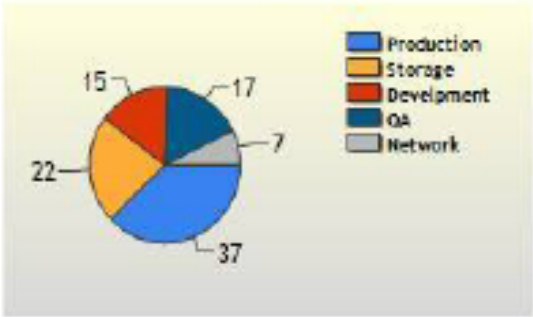
Source: Rittal

- Hot or cold containment
- Supports very high heat
- 20% less energy

Energy Efficiency in Data Centers

It's not about what you use — but how you use it....

Racks/Cabinets Count by Usage

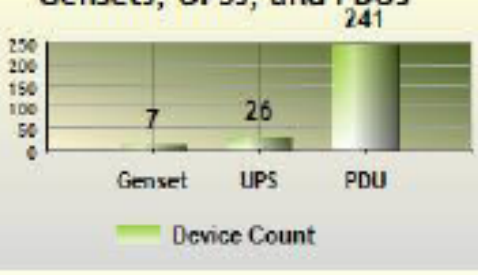


Rack/Cabinet Power By Usage

Usage	Count	Power (kW)	Avg.Power (kW)
Production	37	21.51	0.58
Storage	22	18.17	0.83
Development	15	13.71	0.91
QA	17	12.85	0.76
Network	7	0.87	0.12

Power Assets

Gensets, UPSs, and PDUs



RPPs and ATSs

Source: Aperture Technologies

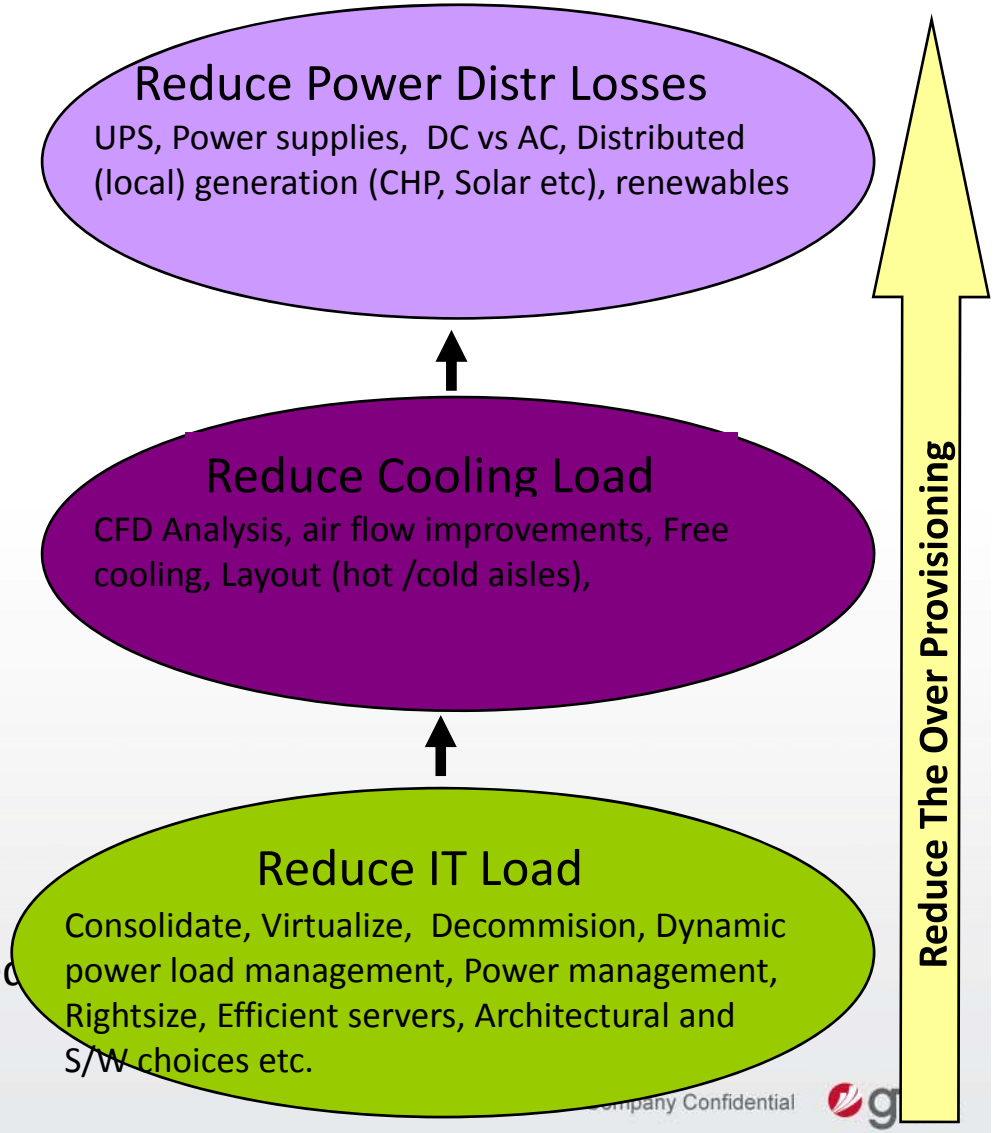
- Optimize the energy utilization of assets
- Visualize the power consumption of resources
- Automate and control server energy usage to optimal levels
- Dynamically move workloads based on policy
- Shut down or power on resources
- Monitor and report consumption
- Use trending and capacity planning tools to manage resource usage proactively

Gartner

Take a Holistic Approach To Reducing IT, Cooling and Power Loads

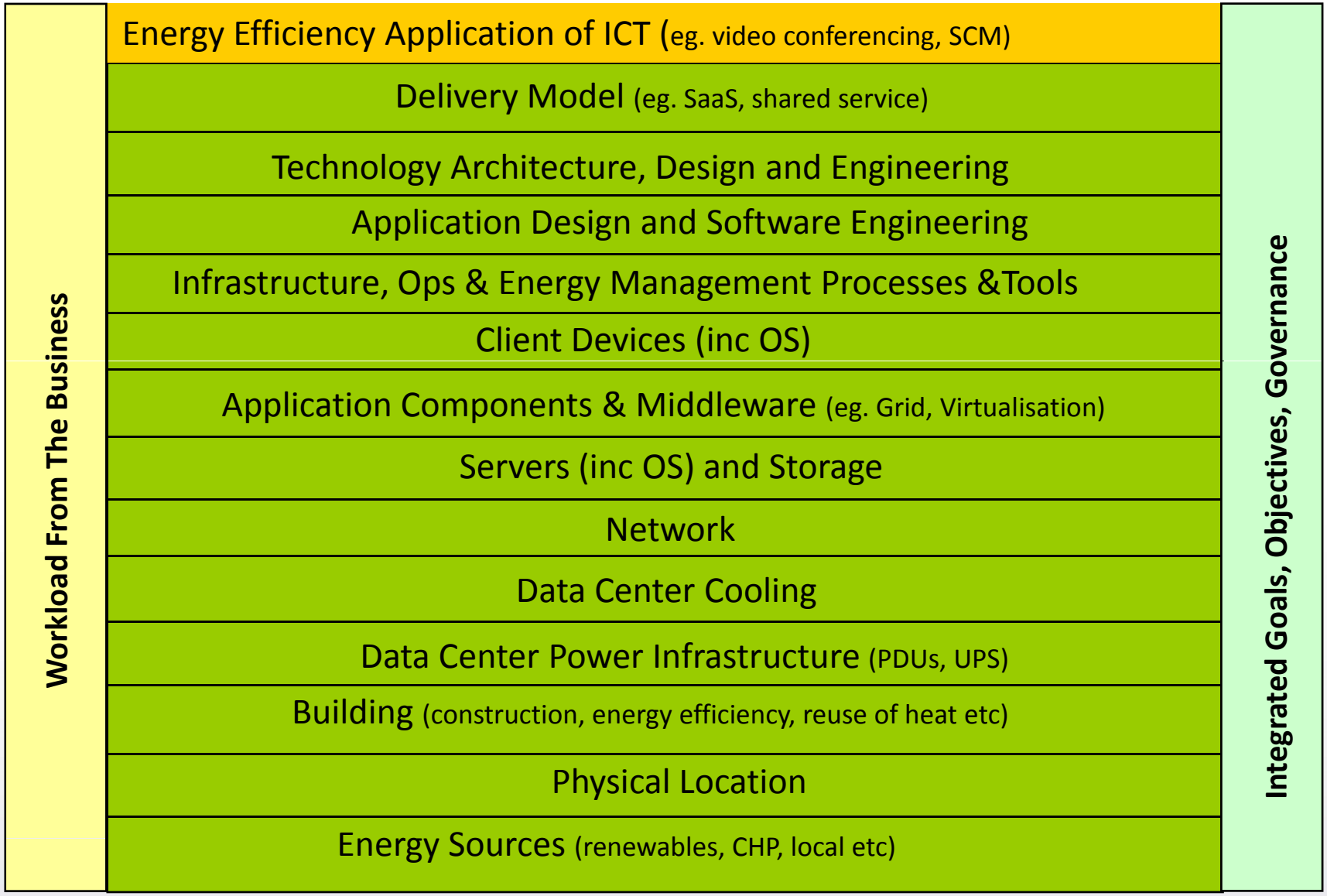
Cooling Efficiency Is A Big Opportunity

- Must be made smarter, more dynamic.
- Check air flows around the data center
- Conduct a CFD analysis
- Investigate local options for free cooling – look at air-side and water-side economizers.
- Bottom-to-top airflow
- Use cold aisle/hot aisle rack configuration
- Maintain static pressure at 5 percent above room pressure
- Avoid air leaks in raised floor
- Use blanking panels
- Plumb new builds for liquid cooling
- Investigate local power generation (combined heat and power particularly)



Source: Gartner

Energy Efficiency At Multiple Levels



Source: Gartner

Best Practices for Energy Efficiency

Action	Savings	How
Virtualize	10%-50%	Push server performance to 65%. Reduce physical footprints.
Air economizers	4%-15%	Use outside air whenever possible. Enable economizer mode in existing equipment.
Rightsizing	10%-30%	Build and provision only what you need today — expand only when needed.
Floor layout	5%-12%	Hot aisle/cold aisle. Reduce air movement (distance).
Power equipment	4%-10%	Best in class UPS. Focus on light load efficiency, not full load.
Cooling	7%-15%	Row- and rack-based cooling for high density. Higher return temperatures.

Source: Gartner

Begin the Journey From Always on, to Always Available

The Data Center Problem

- Everyone is working on power efficiency, but a technology "fix" is more than three years away for most enterprises
- "If it ain't broke don't touch it" — Well, it's broke now
- Energy management and cooling is very static.

The Opportunity

- Low server utilization
- The technology exists to reduce power consumption

The Fix

- Virtualize
- Stop over-provisioning (servers, UPS and cooling)
- Use power management features to throttle power based on use
- Use a low power state or shut servers down when not in use
- Use management software to automate changing the power status of equipment. (Source: Gartner)

GREEN IT 101: Ten Effective Methods to Improve Electrical Efficiency

Physical location of the data centre still matters

It's not all about virtualisation

Local or remote? Factors in play:

Industry vertical

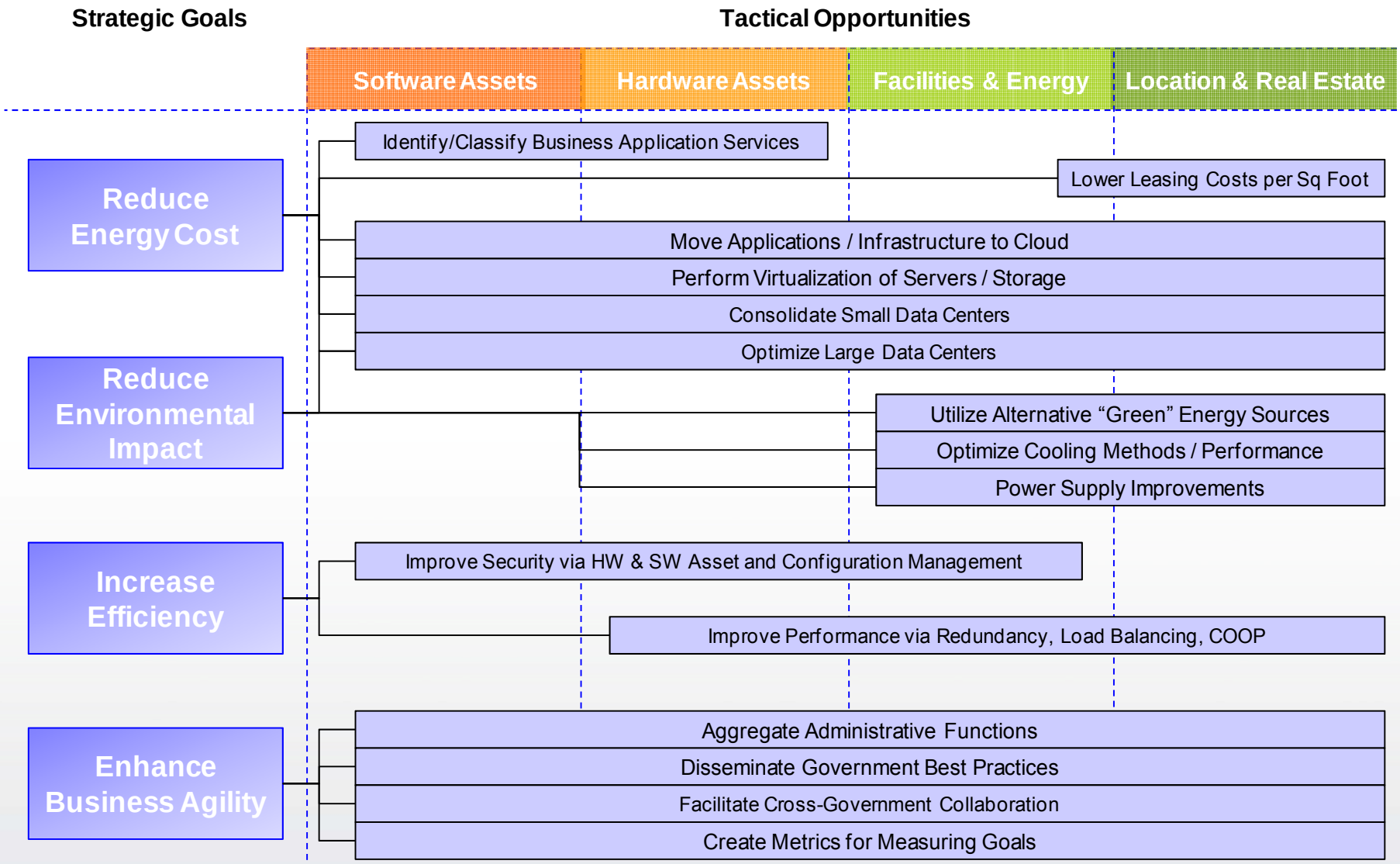
- ***Frequency of data access*** requirements (eg: real-time data record synchronisation)

- ***Storage needs*** (by size) & compliance burden (need to store multiple years' records)

Data storage type

- ***Mission-critical*** (low latency due to synchronisation needs, close location required, survivability paramount)
- ***Business-critical*** operational (remote location acceptable, backup paramount)
- ***Archiving*** (remote location acceptable)

Data Center Consolidation



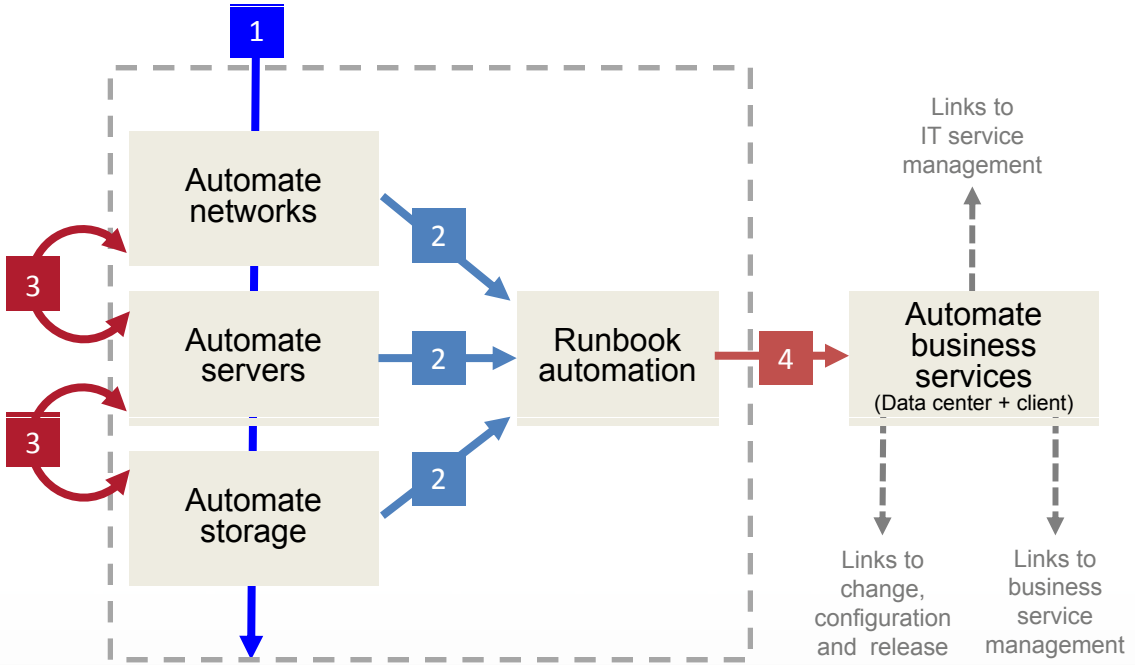
Solutions for data center automation

1 Element automation
Comprehensive automation for networks, servers or storage, spanning all tasks from provisioning and change management to compliance enforcement and reporting

2 Automate common IT processes
Establish runbook automation for common and repeatable IT processes across all infrastructure tiers, IT groups and systems

3 Data center automation
Integrated automation of all aspects of deploying and managing applications, servers, networks, storage and common processes across the entire data center

4 Automate business services
Automate the entire business service with continuous control of each phase of the service lifecycle, across the data center and client end points, from automated operations to monitoring and ticketing



DATA CENTER TRANSFORMATION

Data center automation

Data center consolidation

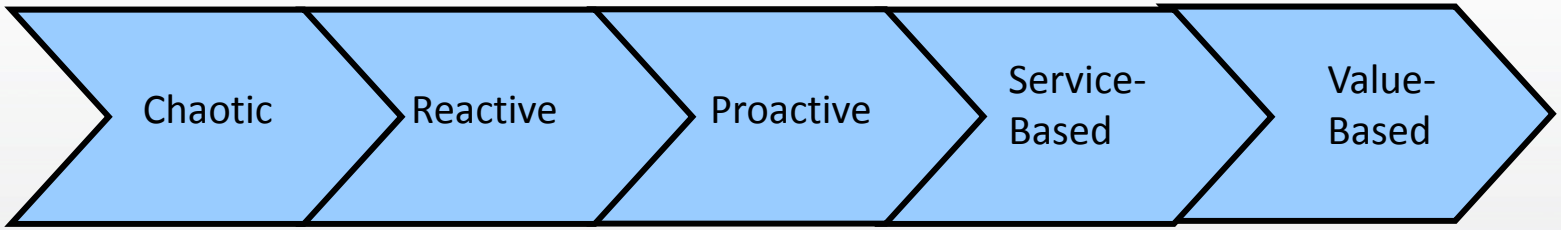
Infrastructure compliance and security

Improve IT Operational Processes

ITIL is a business process framework geared to IT service management. ITIL defines best practices for 10 processes and one function (service desk) and is critical to Data Center Consolidation :

Service Delivery Processes	Service Support Processes
Service-level mgmt.	Incident mgmt.
Financial mgmt.	Problem mgmt.
Capacity mgmt.	Change mgmt.
IT service continuity	Configuration mgmt.
Availability mgmt.	Release mgmt.

ITIL Benefits	ITIL Limitations
Detailed taxonomy	Not an improvement methodology
Emphasis on process	Specifies "what" but not "how"
Process integration	Doesn't cover all processes
Standardization	Doesn't cover organization issues
Focus on customer	Hype driving unrealistic expectations



Secure your Virtualized Infrastructure

Continuous Monitoring

- Perform internal and external vulnerability scans regularly
- Real-time active monitoring bridging both the NOC & SOC
- Discover and monitor file and data activity on the network to block malicious executables and potential data leakage

Guideline for Images

- VM resource management
- Role based access to comply with principles of least privilege and separation of duties
- Disable all unnecessary services to reduce exploitable exposure
- Enforce confidentiality for VMs with logical firewalls (zones)

Patch Management

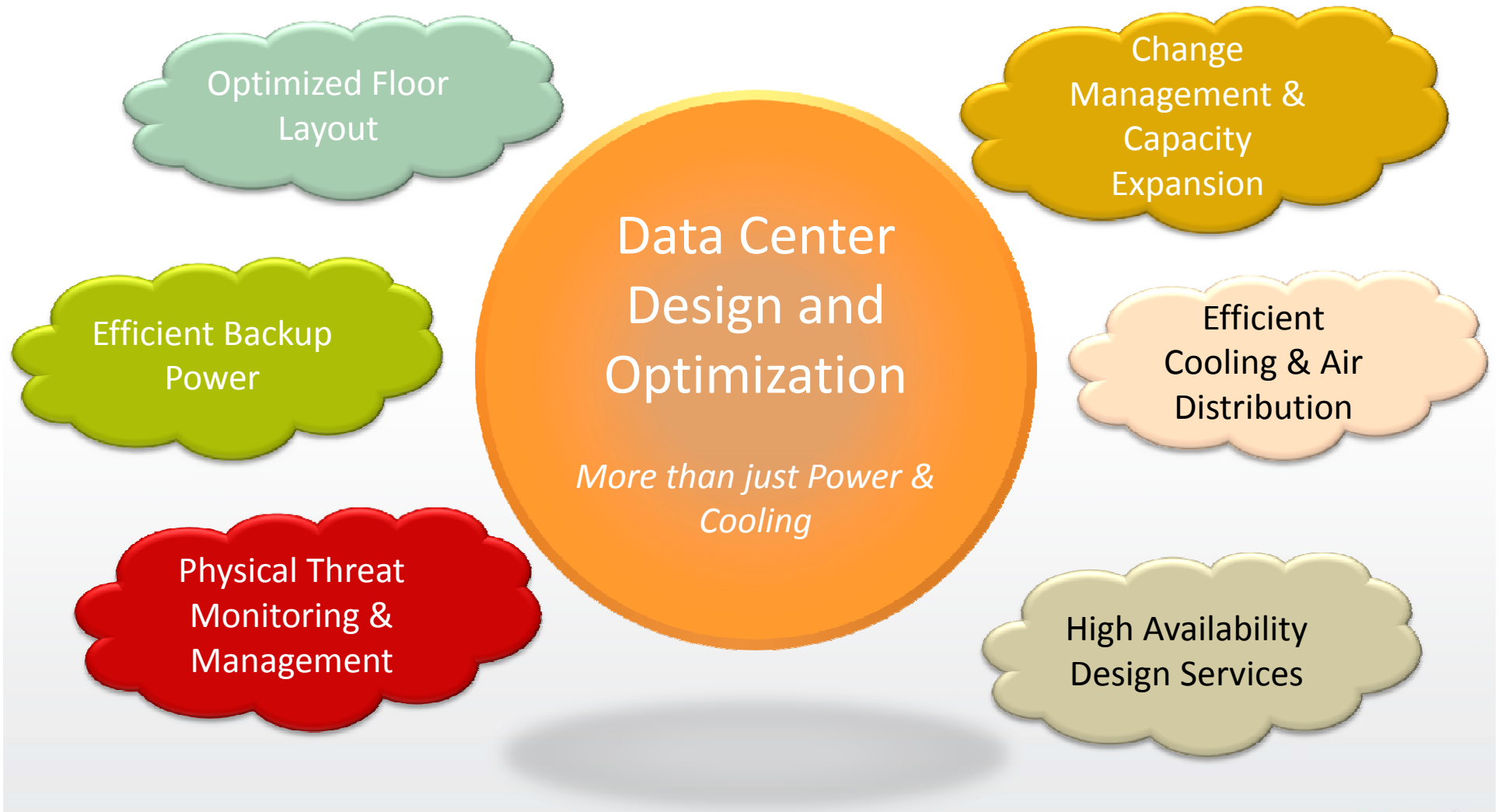
- Patch OS and applications regularly
- Maintain and update inventory of all applications and systems to address inherent vulnerabilities
- Procedures to address security risks for non-patchable systems

Protection Elements

- Host Based Security Systems for both online and offline machines
- Virtual Distributed Switching for greater control and traffic visibility
- Utilizing both Signature-based and Behavioral-based Analysis

Security Management and Control

Data Center Optimization



GTSI Cloud Computing Maturity Model

Step 1 Consolidation	Step 2 Virtualization	Step 3 Automation	Step 4 Utility	Step 5 Cloud
Consolidation & Modernization of Resources	**Abstraction & Resource Pooling**	**Adaptive, Secure, & Repeatable**	**Self-Service & Metering**	**On-Demand & Scalable**
Server Consolidation	Server and Storage Virtualization	Policy-Based Provisioning & Management	Service Metrics & Metering	IaaS, SaaS, PaaS
Tiered Storage Consolidation	Desktop Virtualization	ITIL-Based Repeatable Processes	Service Level Agreements (SLAs)	Service-Oriented Architecture
Consolidation of Network Services	Virtualized Network Services	Multi-Tier Security	Incident Response & Audit	Inter-Cloud Federation
Consolidation of Disparate Applications	Application Virtualization	Multi-Tier Data Recovery	Continuous Availability & Failover	Integration of Web 2.0 and Web Portals
Key Enabling Capabilities	**Key Enabling Capabilities**	**Key Enabling Capabilities**	**Key Enabling Capabilities**	**Key Enabling Capabilities**
Consolidation	Virtualization	ITIL Service Mgmt.	DR & COOP	Cloud Internetworking
Modernization	Thin Client Computing	Network Security	Risk / Vulnerability Management	Integration
Power & Cooling	Green IT	Data Center Security	Situational Awareness	Provisioning
High Performance Computing	Data Deduplication	Infrastructure Protection		

Key Takeaways

- Engage a solution provider that can help you with a thorough datacenter assessment in a heterogeneous vendor agnostic fashion to get a baseline inventory of your assets.
- Follow the best practices & lessons learned
- Take a phased approach
- Assess where your agency is in the continuum with respect to the cloud computing maturity model before you begin the journey of migrating to cloud.
- Start with a Proof of Concept
- Deploy best of breed solutions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