



System z Enables Solutions For A Smarter Planet

Dynamic Infrastructure With System z

Dynamic Infrastructure Requirements

- TCO – Take Costs Out!
- Faster Provisioning
- Secure and Resilient



**Service Oriented Finance
CIO**

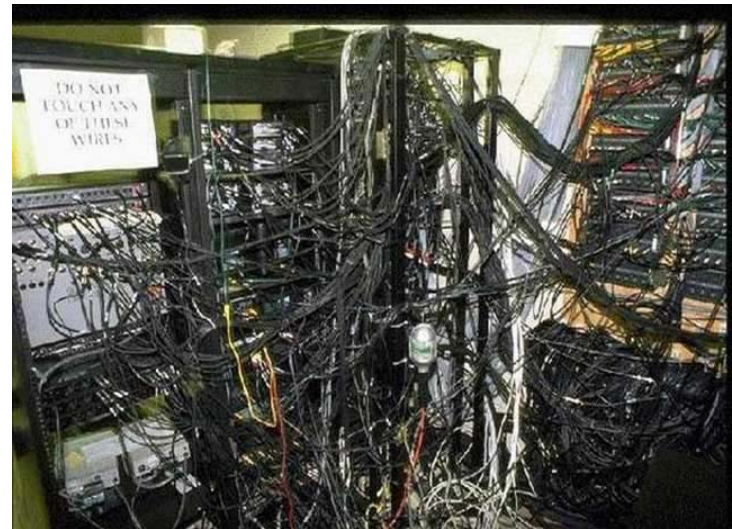
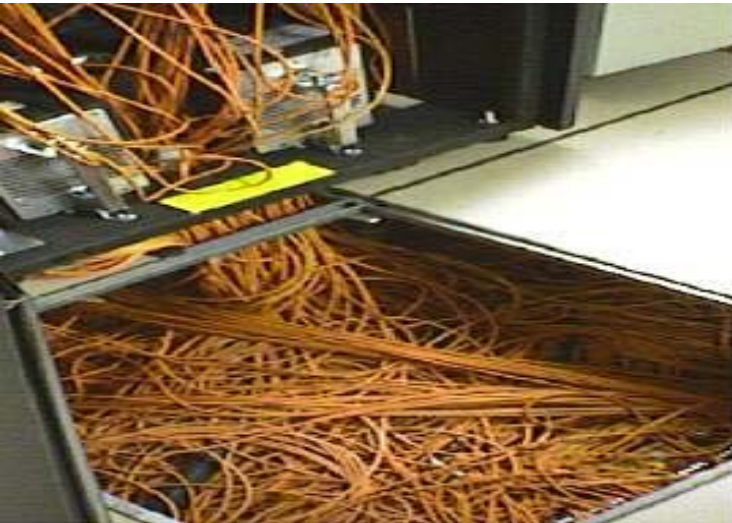
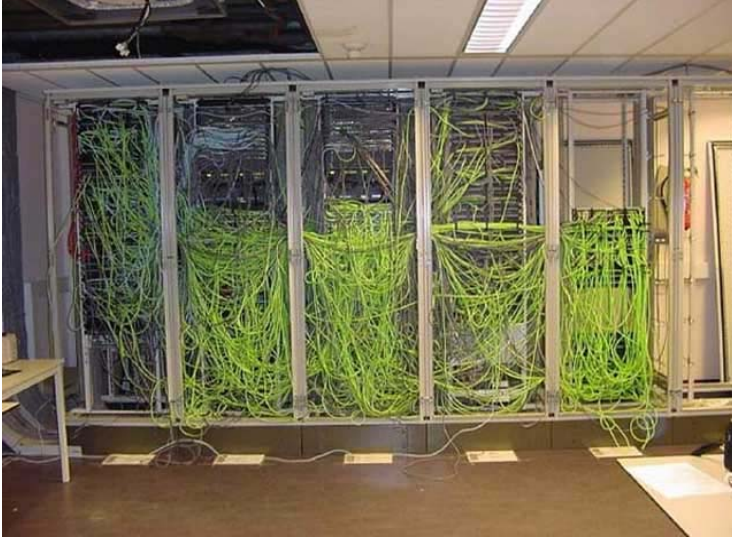
System z delivers all these capabilities today!



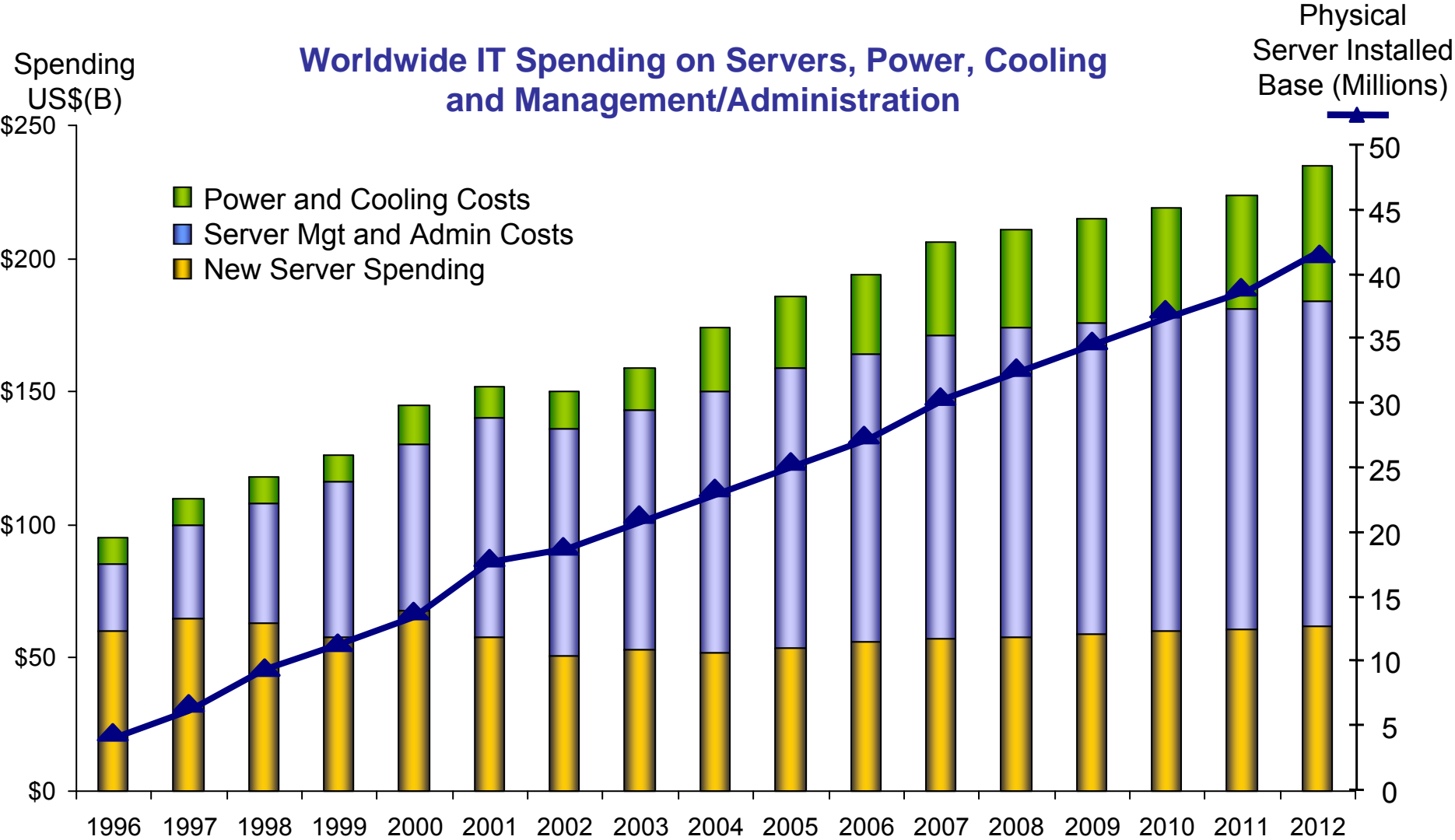
IBM

Complexity Is Growing

- Complexity drives cost
- Reduces responsiveness
- Likely to impact security and performance



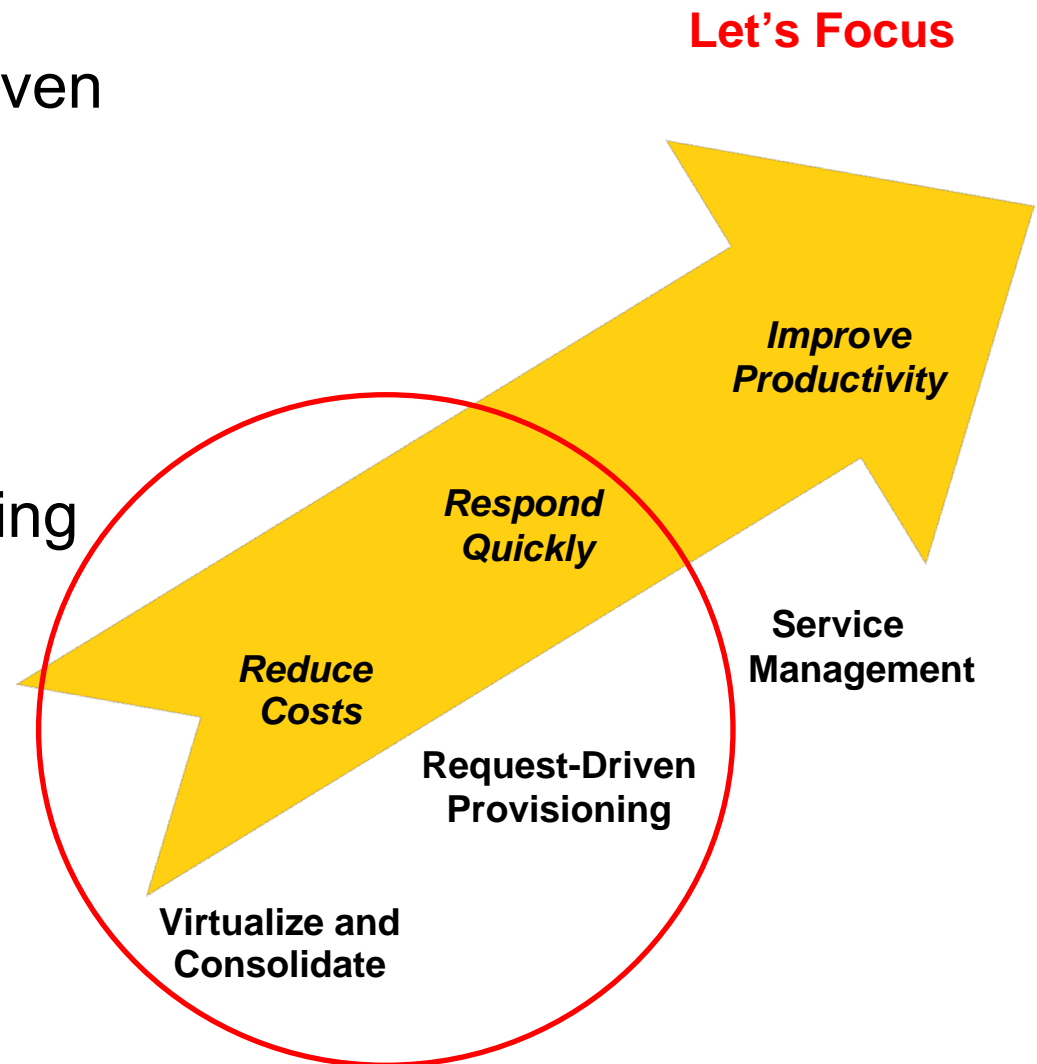
Annual Operating Costs Are Out Of Control



Dynamic Infrastructure For A Smarter Planet

- Virtualization and Consolidation is a proven way to save money
- Start a project now!

- Request Driven, or Automated, Provisioning increases agility and lowers labor costs
- Start a project now!



Understand All The Operational Costs

Annual Operations Cost Per Server (Averaged over 3917 Distributed Servers)

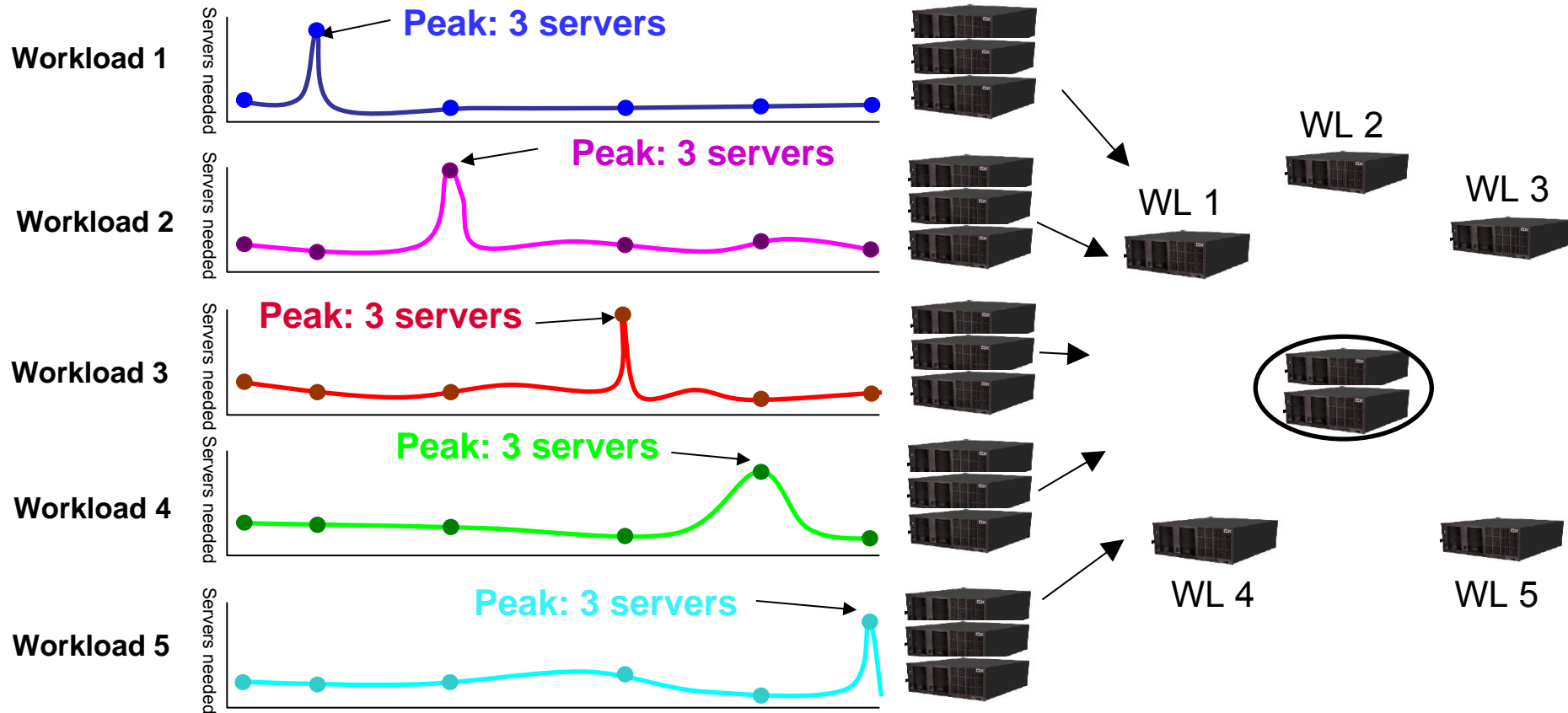
Power	\$731
Floor Space	\$987
Annual Server Maintenance	\$777
Annual connectivity Maintenance	\$213
Annual Disk Maintenance	\$203
Annual Software support	\$10,153
Annual Enterprise Network	\$1,024
Annual Sysadmin	\$20,359
Total Annual Costs	\$34,447

Needed:
Something
that works
on these

The largest cost component was labor for administration
7.8 servers per headcount @ \$159,800/yr/headcount

Source: IBM internal study

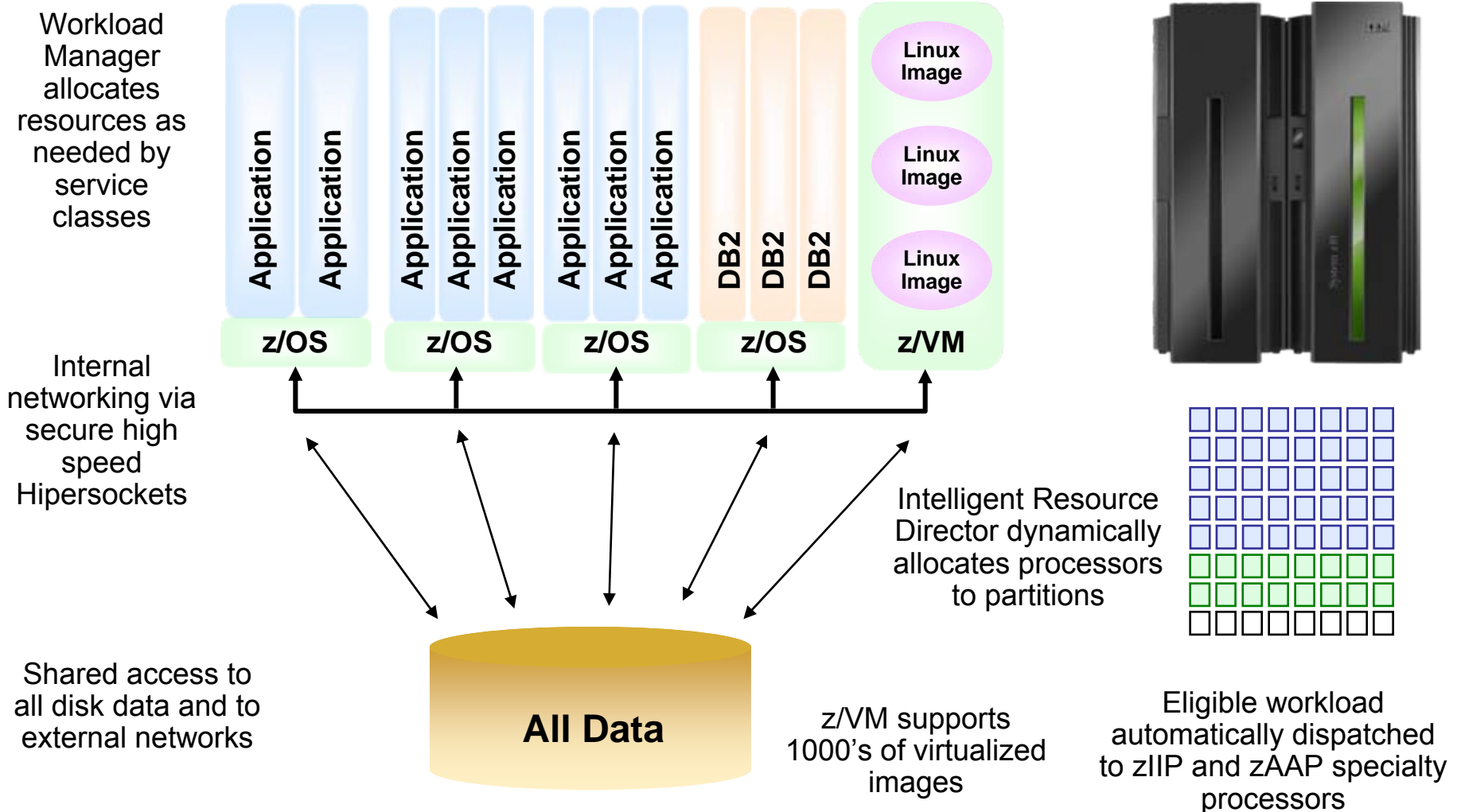
Example: Improve Efficiency And Reduce Costs



What's Required: Virtualization and Intelligent Workload Management to Accommodate Shifting Workloads – automatic on the mainframe!

System z Is Designed For Extreme Virtualization

Logical Partitions Share Processors, Common Cache Structures, and I/O



Linux Server Consolidation On System z Takes Cost Out Because...

- System z IFL processor is deeply discounted
- IBM (and many other vendors) only charge per IFL processor fees for software, not per image
- Consolidation reduces most other annual operations costs
- Simplify networks by removing physical implementation
- Benefit from System z virtualized storage and hierarchical management
- Leverage mainframe systematic disaster recovery
- Consistently use RACF security
- z/VM can provision new virtual servers quickly
- Disk copy of preconfigured images eliminates software install
- z/VM can handle the consolidation of 1,000's of images

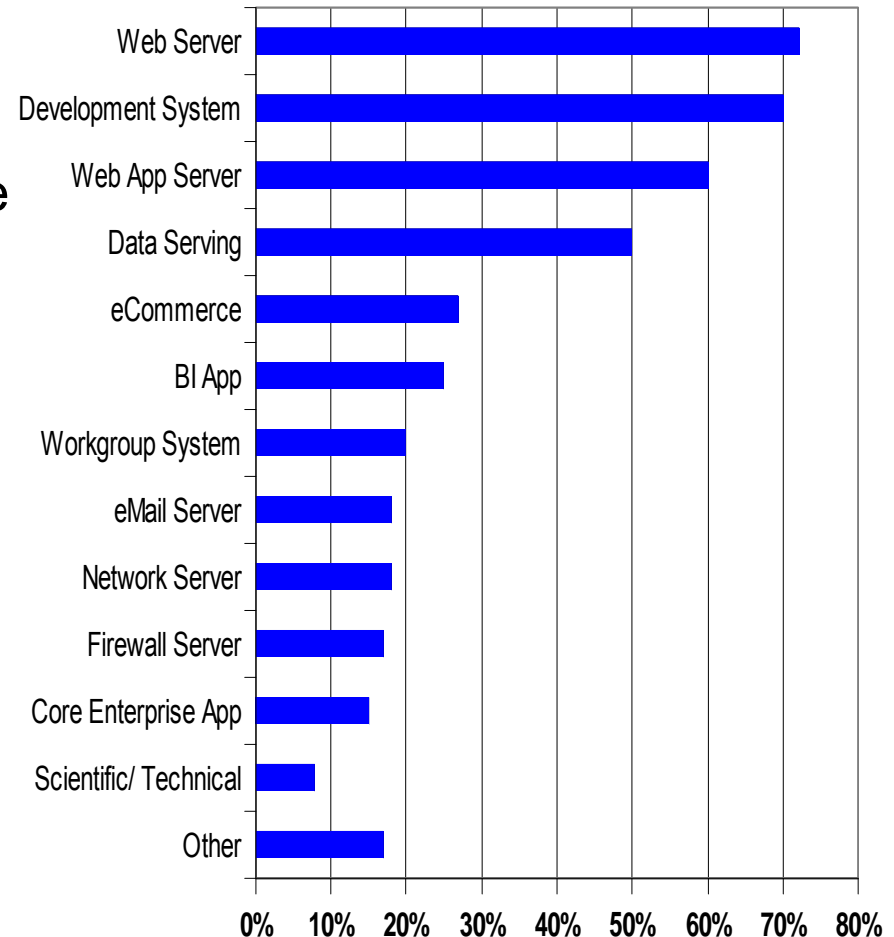
Workloads That Can Be Consolidated In Linux On A Mainframe

What	Where	Specialty Processor	How
Linux Applications	Linux on z/VM	IFL	Recompile
Linux Middleware - IBM Brands (DB2, WebSphere, Lotus, Rational, Tivoli) - Oracle Database - etc.	Linux on z/VM	IFL	Rehost
Linux Packaged Applications - SAP - Oracle - etc.	Linux on z/VM	IFL	Rehost

Linux Workloads On System z

- Clients are deploying Linux on z for a broad set of applications
- Almost 2,500 applications available for Linux on System z
- Leading applications for Linux on System z:
 - ▶ WebSphere
 - ▶ SAP
 - ▶ Domino
 - ▶ Cognos
 - ▶ Oracle

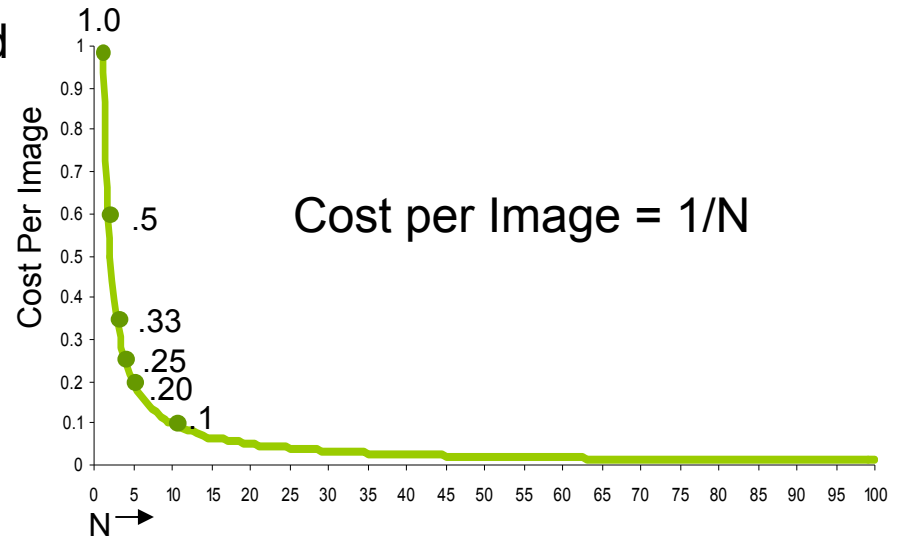
Linux on System z Workloads 2H08



How Much Money Can You Save?

- Costs shared by all “N” consolidated images

- ▶ Hardware
- ▶ Software
- ▶ Power
- ▶ Floor Space
- ▶ Local Network Connectivity



- Costs not shared by consolidated images

- ▶ Migration cost per image
- ▶ Off premise network cost

- ▶ Labor cost per image

Fixed cost per image

Fixed cost per image, but typically less than unconsolidated labor cost

The more workloads you can consolidate, the lower the cost per image

Consolidation Math For Processors

What is the theoretical maximum number of servers that can be consolidated?



N Servers

P_A – Processor Power

U_A – Utilization

C_A – Cores Per Server

One Server

P_B – Processor Power

U_B – Utilization

C_B – Cores Per Server

Ratios

$$P_R = P_B / P_A$$

$$U_R = U_B / U_A$$

$$C_R = C_B / C_A$$

$$N \leq \left(\begin{array}{c} \text{Processor} \\ \text{Performance} \\ \text{Ratio} \end{array} \right) \left(\begin{array}{c} \text{Processor} \\ \text{Utilization} \\ \text{Ratio} \end{array} \right) \left(\begin{array}{c} \text{Cores per} \\ \text{Frame} \\ \text{Ratio} \end{array} \right)$$

$N \leq (P_R) (U_R) (C_R)$

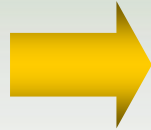
Implementation variations from average and practical considerations will constrain this theoretical number

Identify Consolidation Opportunities

The more servers you can consolidate, the more money you will save (Maximize N)

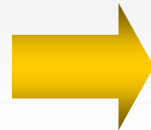
$$N \leq (P_R) (U_R) (C_R)$$

Servers that are candidates to be consolidated



Older servers with slower processor

Servers that are best consolidation platforms



New servers with faster processor

Servers with low utilization

Servers that can achieve sustained high utilization

Servers with a low number of cores

Servers with a high number of cores

Performance Ratio

Utilization Ratio

Core Ratio

Typical Ratios

1.0 - 3.0

10 - 20

1- 64

Consolidation Math Sets Upper Limit But Other Factors Reduce That Upper Bound

- Efficiency of the platform hypervisor can reduce the consolidation ratios achievable
 - ▶ Different efficiency in each major dimension
 - CPU utilization
 - Memory footprint and over commit overhead
 - I/O demand

- Service Level Agreements set further thresholds
 - ▶ Response time norms and maximum
 - ▶ Throughput minimum per virtual server
 - ▶ Overall maximum system CPU utilization

Enough theory! We've been doing some consolidation projects on Intel but IBM keeps suggesting the mainframe would be better – is that really true, can you show me?



**Service Oriented Finance
CIO**

Consolidating your workloads on the mainframe provides the best economy of scale, let's see why!



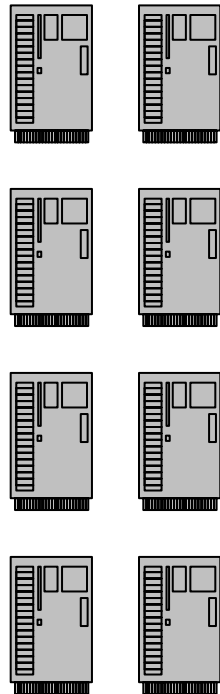
IBM

A Benchmark Comparison

We ran a benchmark to compare how many images can be consolidated in practice

Friendly Bank online banking benchmark (WebSphere Application Server)

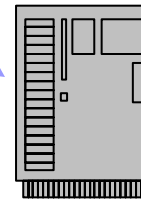
Intel servers x366
4 cores @ 3.66 GHz
1 GB memory



Workload on each one
5% utilization
40 ms response time
4.5 tps



zLinux z10-EC
8 IFL cores @ 4.4 GHz
256 GB physical memory

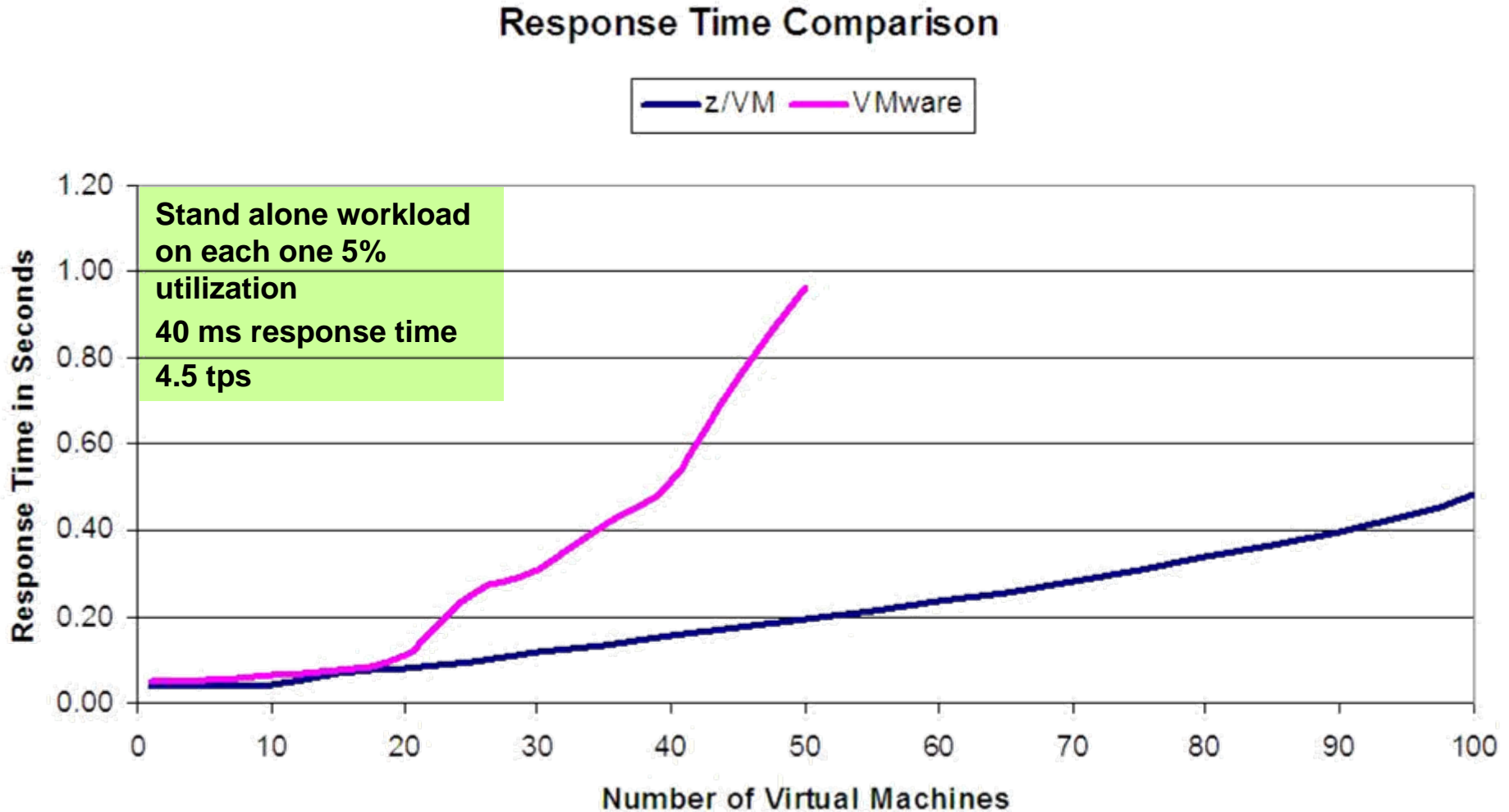


Intel server x3950
8 cores @ 3.5 GHz
64 GB physical memory

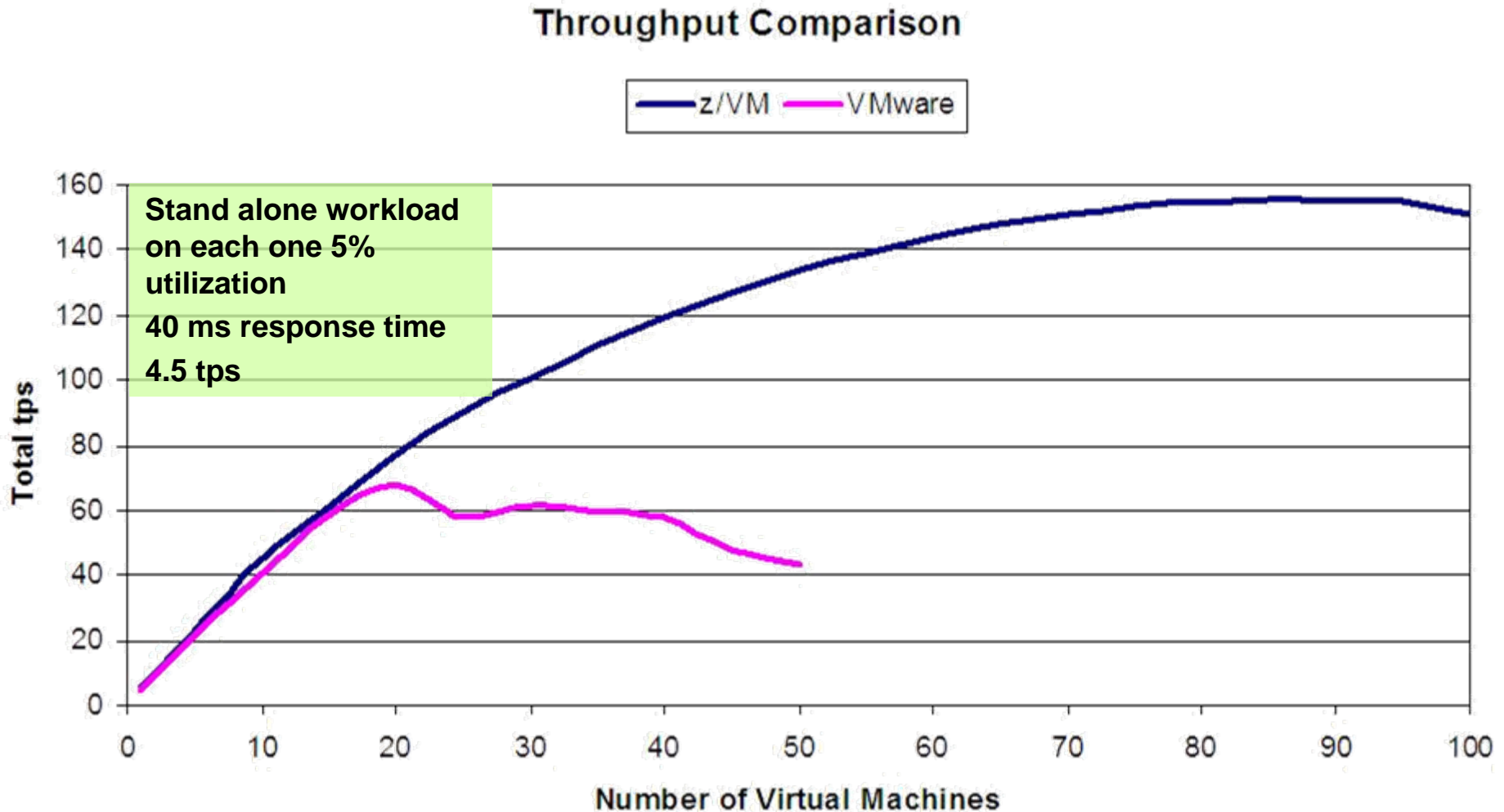
Consolidate VM
images on two
different platforms

Each VM image
4 virtual cores
1 GB virtual memory

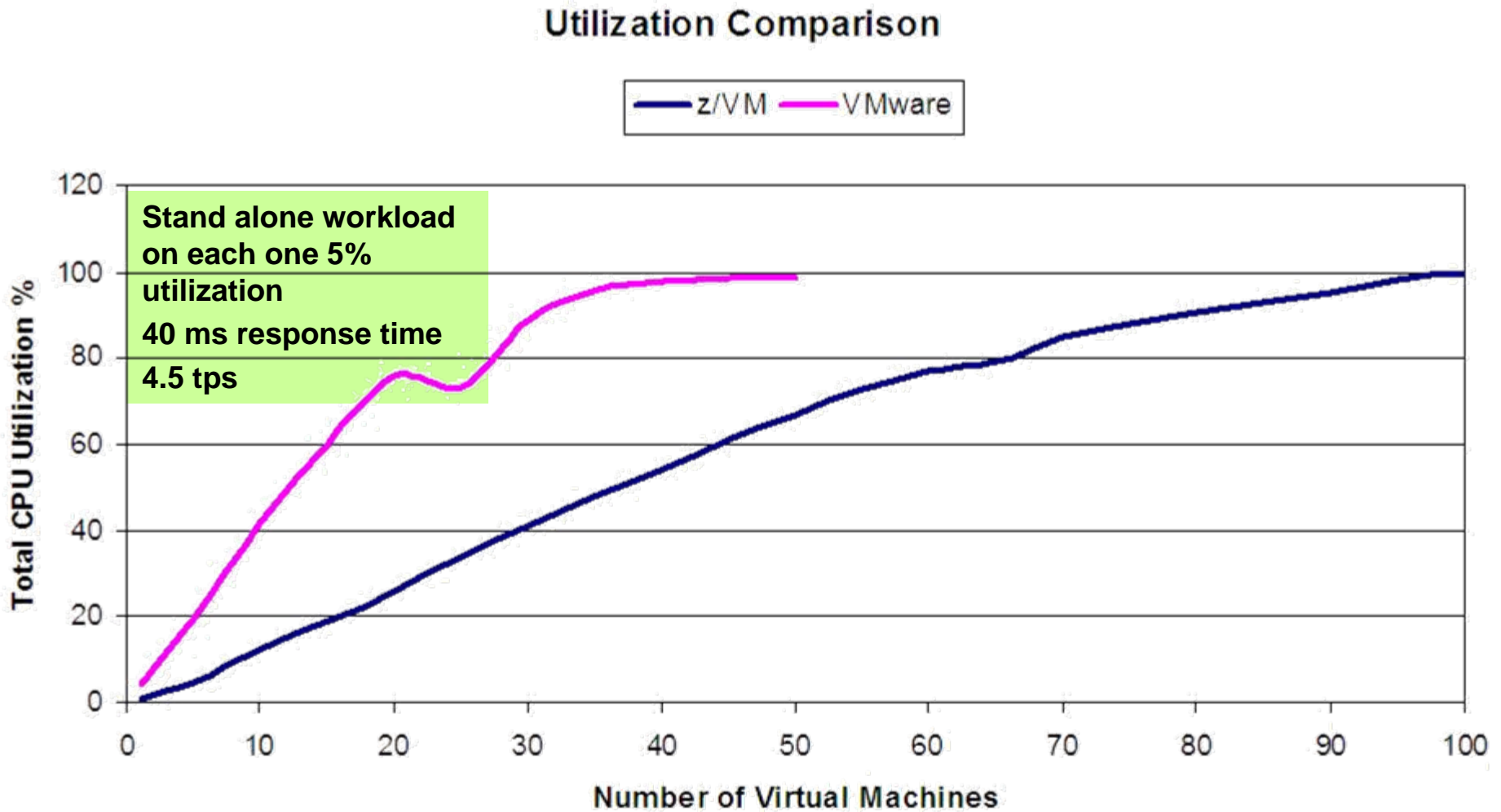
Benchmark Response Time Comparison



Benchmark Throughput Comparison



Benchmark Utilization Comparison

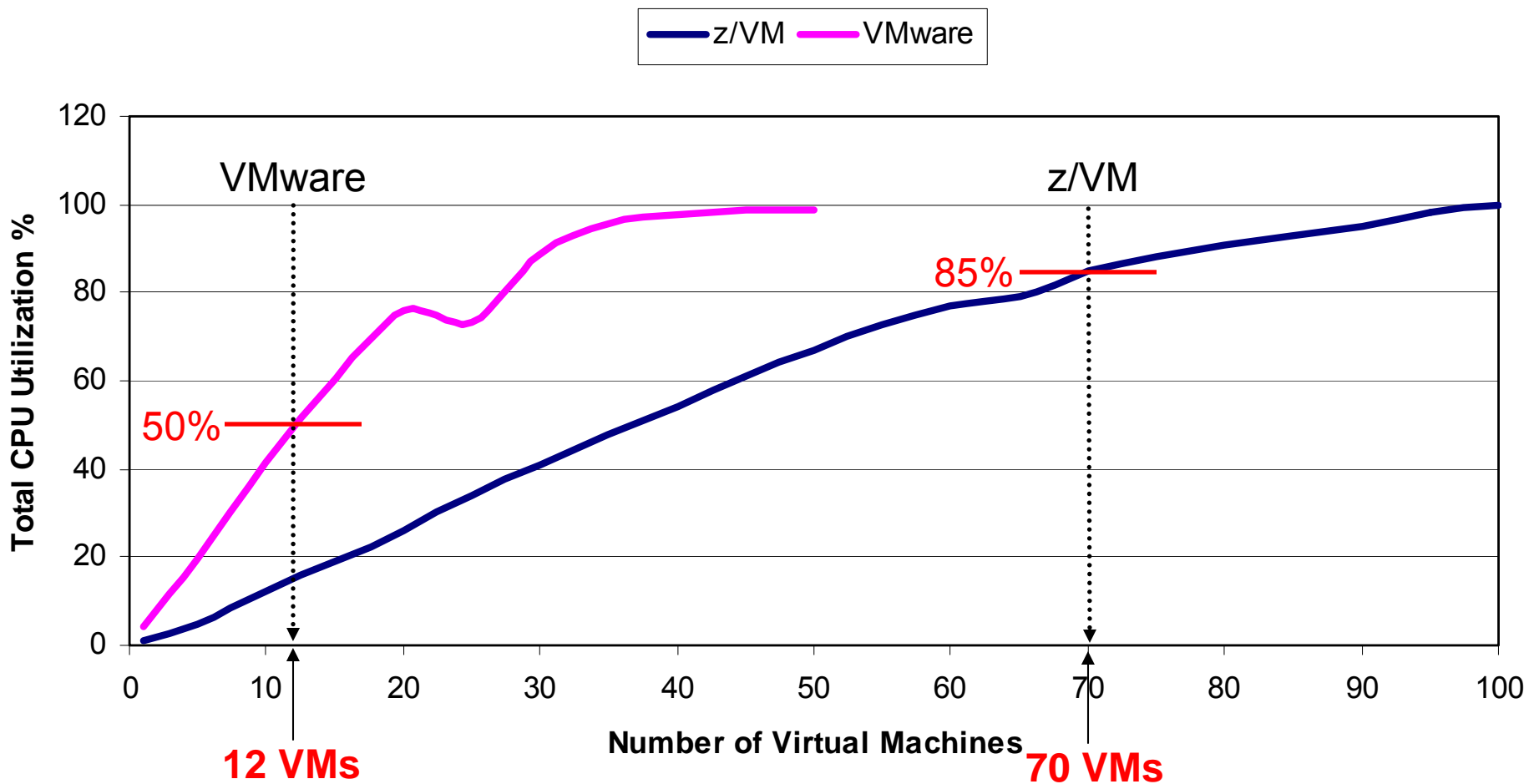


Apply Service Level Agreement Parameters To Determine Actual Consolidation Ratio

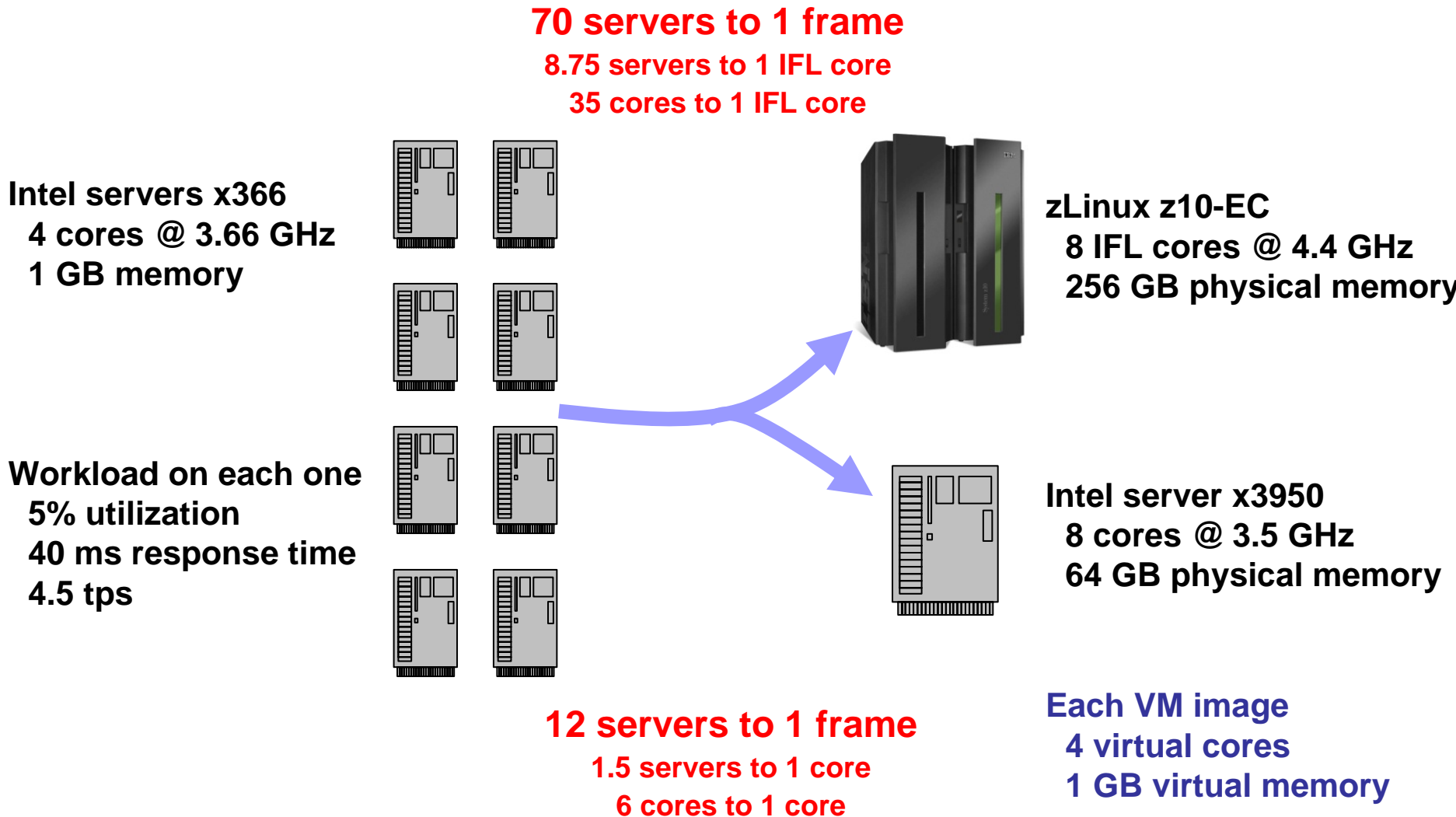
- Response time and throughput objectives can be used
 - ▶ Numbers will depend on specific workloads
- One customer tracked average utilization of the consolidation platforms
 - ▶ We would like to run utilization high enough to achieve the highest consolidation ratio
 - ▶ But less than 100% to allow for statistical peaks caused by variance in the workload
 - ▶ Linux on System z – 85%
 - ▶ VMware/Intel platforms – 50%

Implied Consolidation Ratios Based On Utilization Targets

Utilization Comparison



Consolidation Ratios Needed To Satisfy Service Level Agreement



Case Study: Consolidate On Mainframe vs. Keeping Existing Dedicated Servers

Existing Mainframe



Existing processors:
4 general purpose

Add LPARs for Intel Server Consolidation



Add 28 IFL cores:

*3 year TCO
\$13.52M*

*Annual operating
cost \$1.54M*

*Breakeven in first
year*

*3 year TCO
\$22.27M*

*Annual operating
cost \$7.42 M*

*Existing 245
Standalone
Servers*



**8.75 servers
to 1 IFL core**

*Or maintain existing 245
machines in Intel server farm*



Case Study: Consolidate On Mainframe vs. Keeping Existing Dedicated Servers (3 Yrs)

Mainframe Incremental Hardware

Mainframe Software

OTC		ANNUAL	
28 IFL Processors	\$3,500,000	Power/Space	\$16,884
		Hardware ¹ Maintenance	\$490,224
RAM (160GB)	\$960,000	Systems Admin	\$551,651
Disk Acq.	\$412,403	Disk Maintenance	\$11,856
Migration	\$4,128,495		
TOTAL	\$9,000,898	TOTAL	\$1,070,615 (yr 2,3)

OTC		ANNUAL	
z/VM	\$393,750	z/VM	\$98,525
		WAS S&S	\$116,928
		Linux S&S	\$252,000
TOTAL	\$393,750	TOTAL	\$467,453

Dedicated Hardware

Dedicated Software

OTC		ANNUAL	
Sunk Cost	\$0	Power/Space	\$420,665
		Hardware Maintenance	Sunk Cost
		Systems Admin	\$4,979,135
		Disk Maintenance	Sunk Cost
TOTAL	\$0	TOTAL	\$5,399,800

OTC		ANNUAL	
Sunk Costs	\$0	WAS S&S	\$1,705,200
		Linux S&S	\$318,255
TOTAL	\$0	TOTAL	\$2,023,455

¹ First year maintenance free

Case Study: Consolidate On Mainframe vs. Consolidate On VMware (5 Years)

Existing Mainframe



Existing processors:
4 general purpose

Add LPARs for Intel Server Consolidation



Add 28 IFL cores

*5 year TCO
\$16.59M*

*Annual operating
cost \$1.54M*

Existing 245 Standalone Servers



**8.75 servers
to 1 IFL core**

*Or consolidate existing 245
machines onto 21 large Intel servers*

*5 year TCO
\$18.60M*

**12 servers to 1
(1.5 servers to 1 core)**



*Annual operating
cost \$2.16M*

Case Study: Consolidate On Mainframe vs. Consolidate On VMware (5 Years)

Mainframe Incremental Hardware

OTC		ANNUAL	
28 IFL Processors	\$3,500,000	Power/Space	\$16,884
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Mainframe Software

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		Linux S&S	\$252,000
TOTAL	\$393,750	TOTAL	\$467,453

VMware Hardware

OTC		ANNUAL	
New Servers	\$1,087,485	Power/Space	\$44,121
Tech Refresh (yr 5)	\$1,087,485	Hardware Maintenance	Paid in acq.
Disk Acq.	\$744,432	Systems Admin	\$1,614,393
Migration	\$4,541,345	Disk Maintenance	\$31,872
TOTAL	\$7,460,747	TOTAL	\$1,690,386

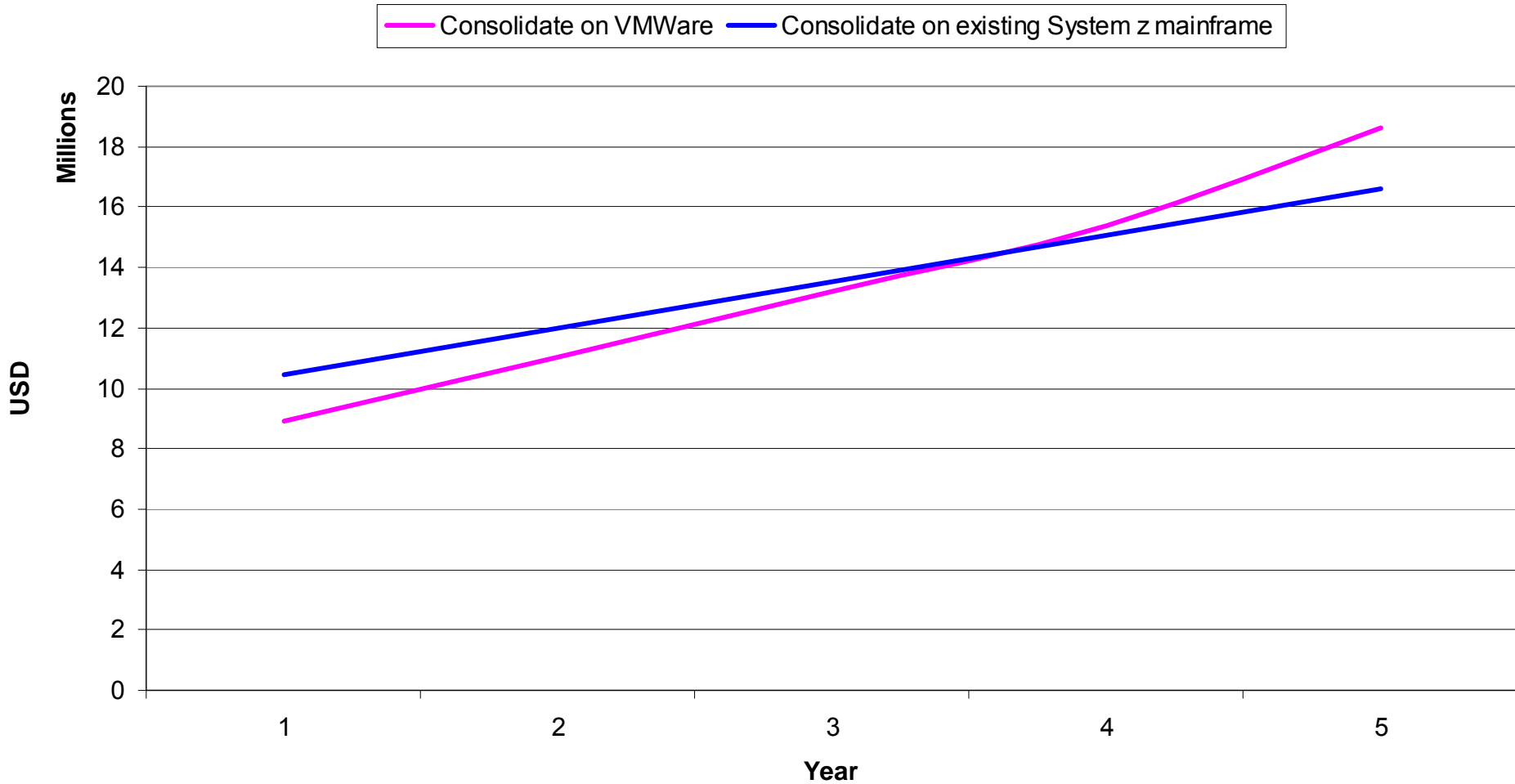
VMware Software

OTC		ANNUAL	
VMware	\$483,000	VMware S&S ¹	\$120,750
		WAS S&S	\$292,320
		Linux S&S	\$52,479
TOTAL	\$483,000	TOTAL	\$465,549 (yr 2-5)

¹ First year maintenance free

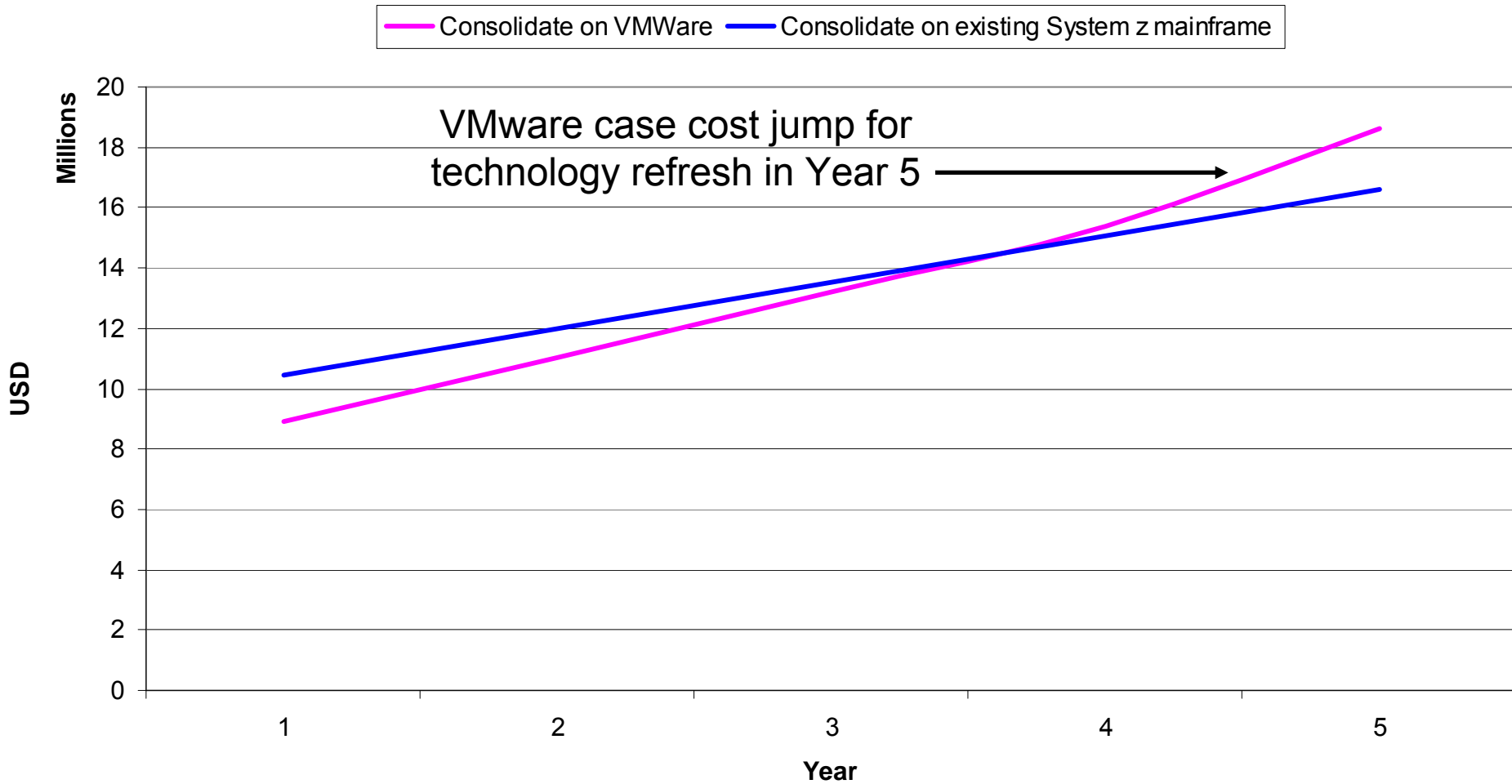
VMware TCO Result

Comparative cost case (Cumulative)



VMware TCO Result

Comparative cost case (Cumulative)



In Benchmarks, Linux On System z And VMware Are Close In Total Cost of Ownership

- However System z provides better qualities of service
 - ▶ Better platform reliability and serviceability
 - ▶ Higher I/O bandwidth
 - ▶ Opportunity to use RACF for consistent security
 - ▶ Systematic and automated disaster recovery for Linux workloads
- And there are additional System z cost savings not yet discussed
 - ▶ Low cost of disaster recovery backup (Backup capacity on demand)
 - ▶ Specialty processors are upgraded free when growing z/OS
 - ▶ Smooth predictable growth of capacity as workloads grow
 - ▶ The richer the software stack, the greater the System z advantage

Bank Of New Zealand Consolidated Their Front-End Sun Servers To A Single Mainframe

bnz



Combination of z/VM and Red Hat Linux enabled BNZ to virtualize a largely distributed Sun environment, which incorporates all of its front-end systems, down to just one box

- Consolidated 131 Sun SPARC systems to the new mainframe system
- Reduced front-end systems datacenter footprint by 30%
- Reduced front-end power consumption by nearly 40%
- 39% reduction in carbon dioxide emissions
- 20% ROI expected over the life of the platform

Bank Of New Zealand Scenario

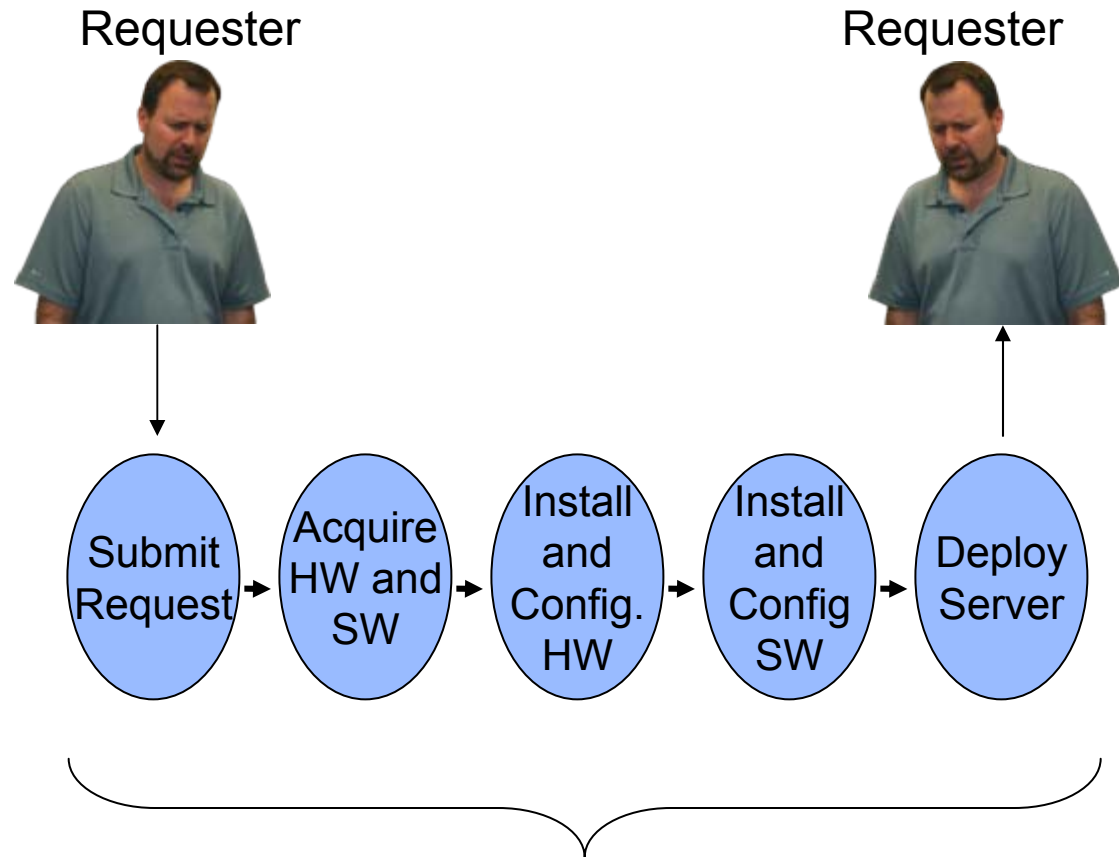
	FROM ...	TO....
Current HW infrastructure	Sun SPARC (e10K, v440, 280R)	z10 EC
Footprints	131	1
Cores / Memory	Many hundreds of cores Thousands of GB	5 IFLs, 160 GB Storage
Application	Front-end IT environment, incl. the internet banking and back teller functions through to backend data	
OS	Solaris (multiple versions)	Linux + z/VM
Energy / Space / Other:		
Power (kWhr)	36 kWhr	22 kWhr -> 38% less
Heat (kBTUs/hr)	110 kBTUs/hr	74 kBTUs/hr -> 33% less
Space (racks)	6,5 racks	4,5 racks -> 31% less
CO2 (tonnes)	66 tonnes	40 tonnes -> 39% less
Summary of Benefits: <ul style="list-style-type: none"> • Maximize space, keep costs down and reduce carbon footprint • Boost the speed of new deployments 		

Deploying New Applications And Services Is Difficult And Time-Consuming

We need to be more responsive. It can take us up to **6 months** to provision a new server!



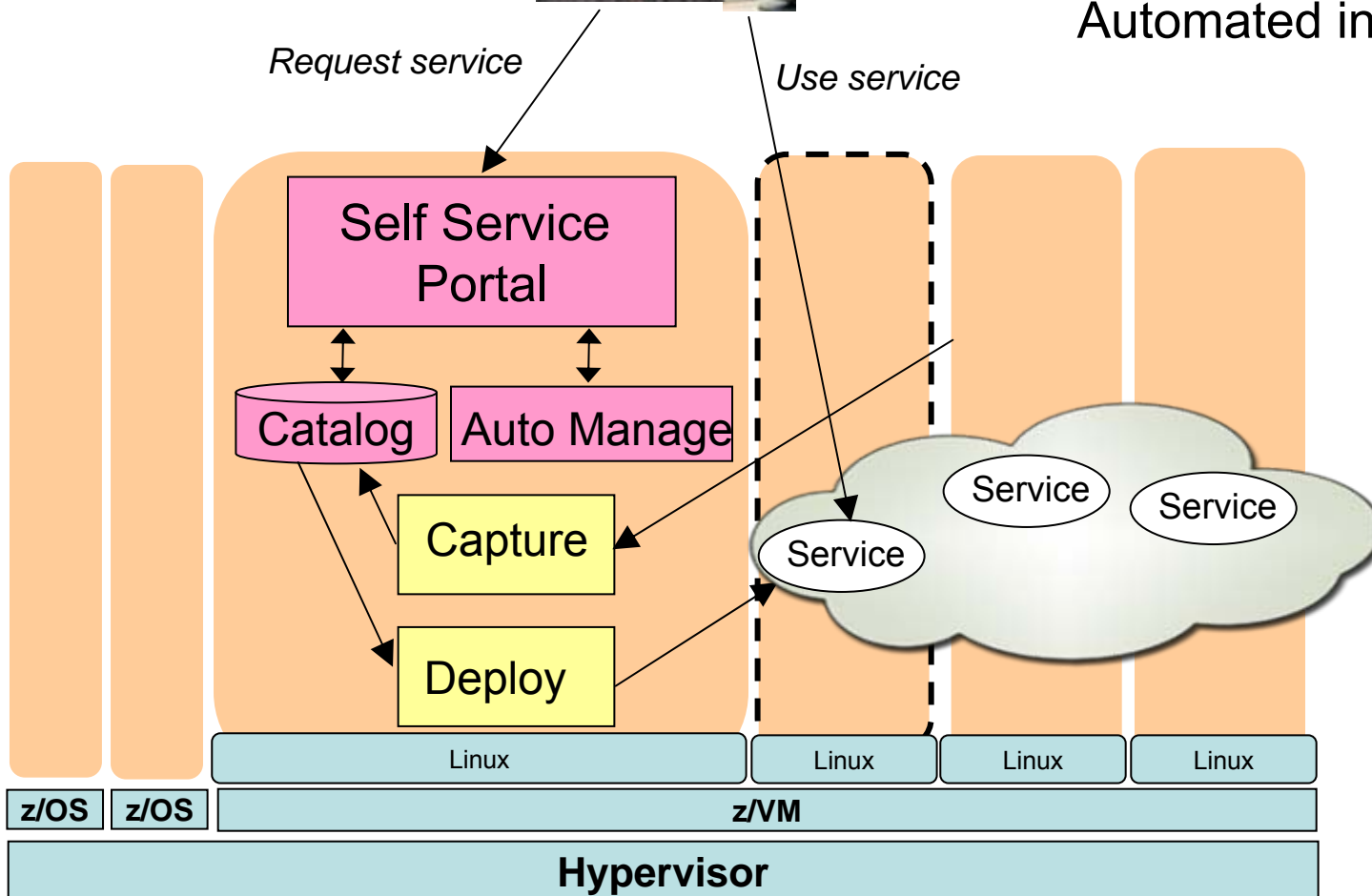
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CIO



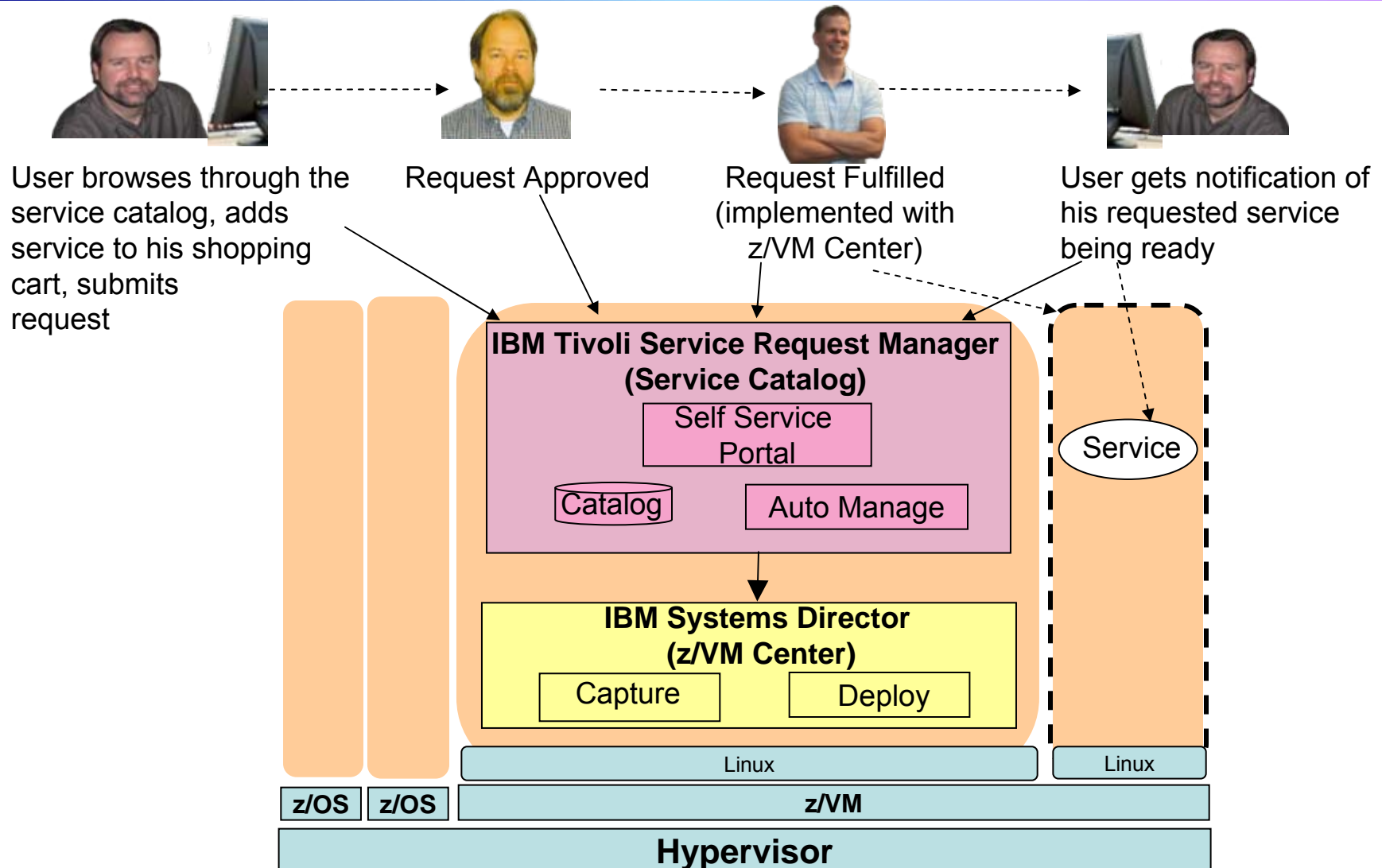
Automated Self Provisioning Reduces Labor Costs



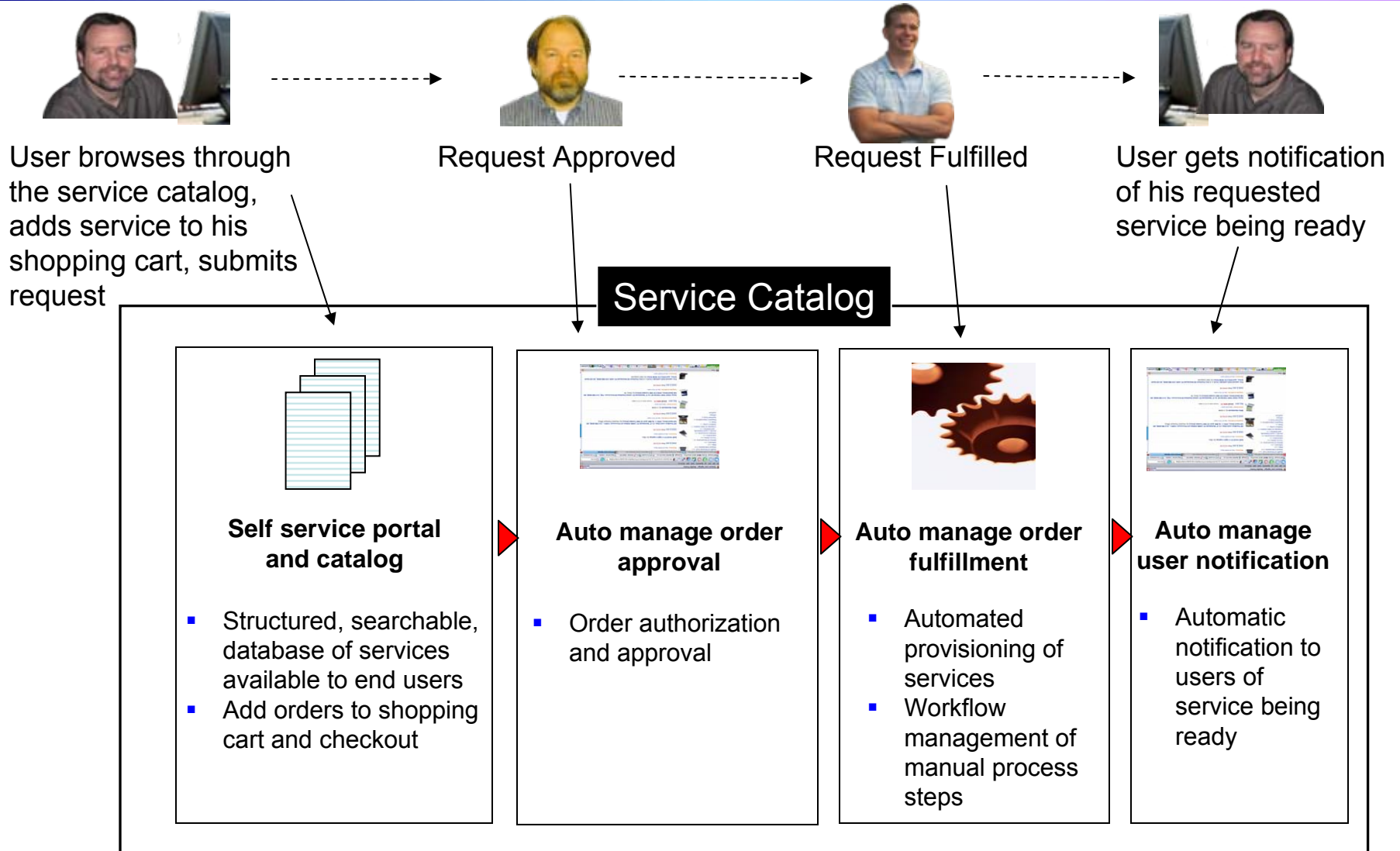
Deploy via:
Image copy (fastest)
Automated install (scripts)



Example – User Requests New Virtual Image On System z To Test Loan Application



Tivoli Service Request Manager (Service Catalog)



Out-Of-Box Service Catalog Content

Service Line	Service Line Component	Service Definition
Server Systems Management	Server Management	Build New Standard Server Image
		Build New Standard Server Image with Middleware
		Deploy Server to Floor
		Perform Initial Build Activities
		Server Lock Down
	DB Subsystem Support	DBMS Install and Configure
		Add Database to Server
		Remove Database from Server
	Middleware Support	Middleware Install and Configure
Distributed Client Services	IMAC	Office Move
		Minor Facility Request
Enterprise Security Management	Identity and Access	Lotus Notes ID - Change Password
		Lotus Notes ID - Change User Name or Certifier
		Lotus Notes ID – Create/Delete Account
		ID Request
Data Network Services	Operations	Firewall Service Request
Fixed Cost Service Requests		Minor Site Enhancement
		I&S Network Consulting
		Bandwidth Analysis Assessment
Composite Service Examples		Build New Server
		Build New Server with Middleware

Demo: Tivoli Service Request Manager

- User browses through Service Catalog
- Adds services to shopping cart
- Submits request

Shopping Cart

Bulletins: (1) Go To Reports Start Center Profile Sign Out Help

Shopping Cart

Cart: 1025 **Build New Server with Middleware** Requested By: [Redacted]

Required Date: [Redacted] Requested For: SRMSELFSEV [Redacted]

Priority*: 1 Total Price: 1,125.00

Please enter Shipping and Charge Information, and then submit your request.

Shipping Information		Charge Information	
Ship to: PMSCRTPMAIN	GL Debit Account: [Redacted]	Location: [Redacted]	[Redacted]
Address: [Redacted]	Asset: [Redacted]	Card Type: [Redacted]	[Redacted]
City: [Redacted]	Card #: [Redacted]	Card Verification Value: [Redacted]	[Redacted]
State/Province: [Redacted]	Expiration Date: [Redacted]		
ZIP/Postal Code: [Redacted]			
Drop Point: [Redacted]			

Items in Cart: Filter 1 - 1 of 1

Line	Quantity	Required Date	Item	Description	Line Price
1	1.00	2008-10-03 08:00:00	PMSC_0021A	Build New Server with Middleware	1,125.00

Continue Shopping Submit Save Cancel

Value Of Automated Provisioning

- Automation reduces the labor (time and effort) required
- Time to initial deployment is reduced
- Better image control yields improved stability of systems
- Consistent configurations between test and production minimizes differences across environment
- Critical updates (security, stability, performance) can be automated and scheduled across all systems
- Changes to systems can be automated and scheduled by the support team

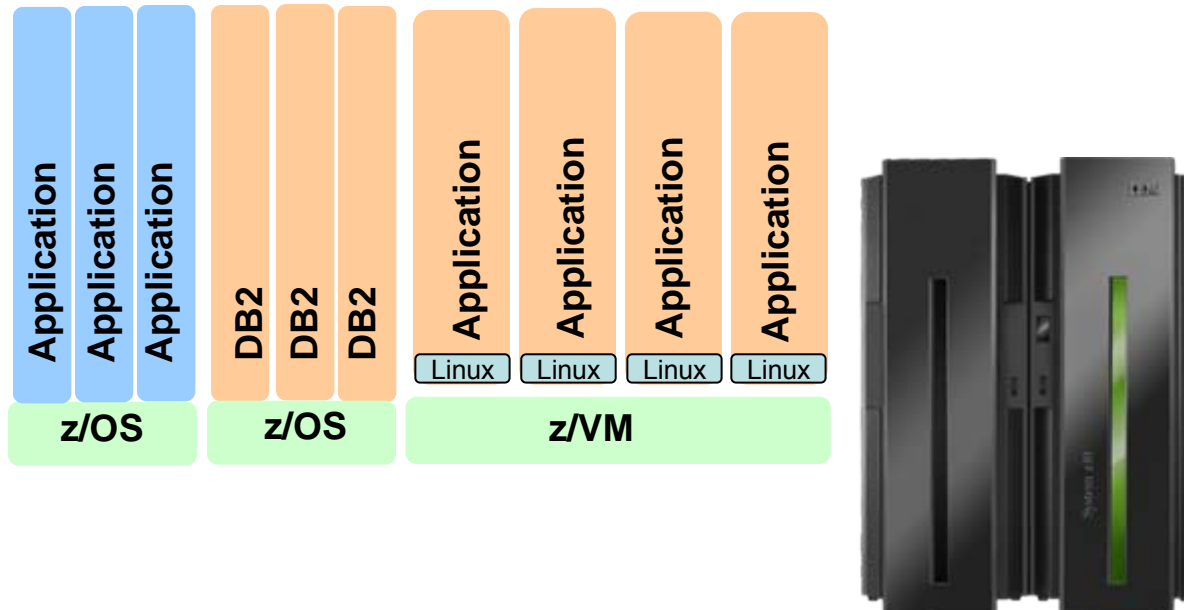
Techniques For Automated Provisioning

- Clone pre-configured image templates using disk copy
 - ▶ z/VM Center
 - ▶ Very fast

- Install and configure environments based on pre-built workflows
 - ▶ Tivoli Provisioning Manager (TPM)

Demo: Provisioning Using z/VM Center

Create a new Virtual Server quickly from existing template using disk cloning



IBM Systems Director

- IBM Systems Director Extensions for System z includes z/VM Center
 - ▶ Provides functions to deploy new z/VM virtual Linux systems easily using templates
 - ▶ Manage an individual virtual server
 - Define and manage individual Linux systems
 - ▶ Manage server complexes
 - Define and manage multiple Linux systems in a server complex
 - A server complex has a configuration profile that defines
 - Network settings
 - Linux configuration scripts
 - Disk access
 - VM Resource Manager (VMRM) performance goals
 - Configuration applicable to all Linux systems in the server complex

- IBM Systems Director provides base platform management
 - ▶ Included with purchase of IBM Systems
 - ▶ Provides common management tools for System z, Power Systems, System x, and BladeCenter

Tivoli Provisioning Manager

- Automates manual tasks of installing and configuring environments
 - ▶ Operating systems
 - ▶ Patches
 - ▶ Middleware
 - ▶ Applications
 - ▶ Storage and network devices
 - ▶ Virtual environments
- Tasks automated through best practice automation workflows
 - ▶ Pre-built workflows describe provisioning steps
 - ▶ Automation package developer environment to customize for data center best practices and procedures
 - ▶ Automatic workflow execution with verification at each step

A Plan For Consolidation

- Pick Linux workloads that are easy to migrate and will save you money
 - ▶ Middleware
 - ▶ Infrastructure
 - ▶ Packaged applications
 - ▶ C/C++ (recompile)
 - ▶ Open source may not yield same cost savings
- Use consolidation math to identify servers with low utilization, older processors, and few cores per server
- For large scale consolidation projects, consider grouping workloads for consolidations on different platforms
 - ▶ By location
 - ▶ By function
 - ▶ By workload type
- Investigate the use of automated provisioning in order to start delivering cloud based services on top of a dynamic infrastructure
- Be prepared to compare the cost of consolidation on System z Linux vs consolidation on VMware/Intel

Summary

A Dynamic Infrastructure with System z
can **Take Costs Out**



IBM

