System z Enables Solutions For A Smarter Planet

Dynamic Infrastructure With System z

Dynamic Infrastructure Requirements

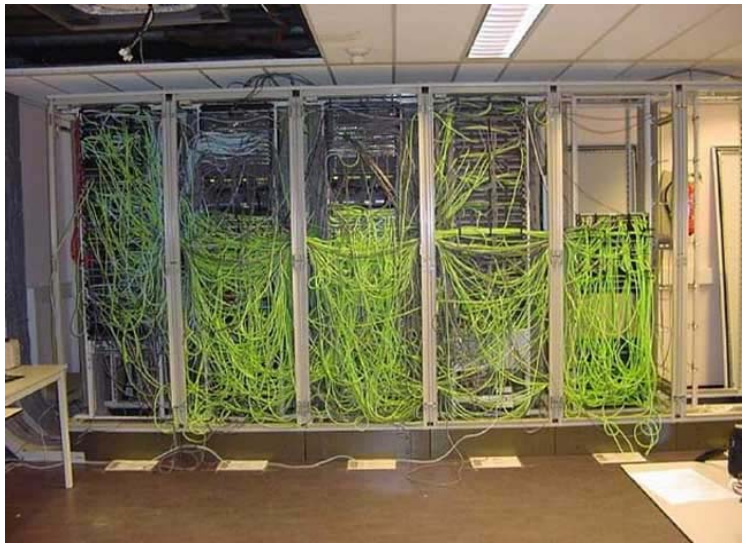
- TCO – Take Costs Out!
- Faster Provisioning
- Secure and Resilient

Service Oriented Finance CIO

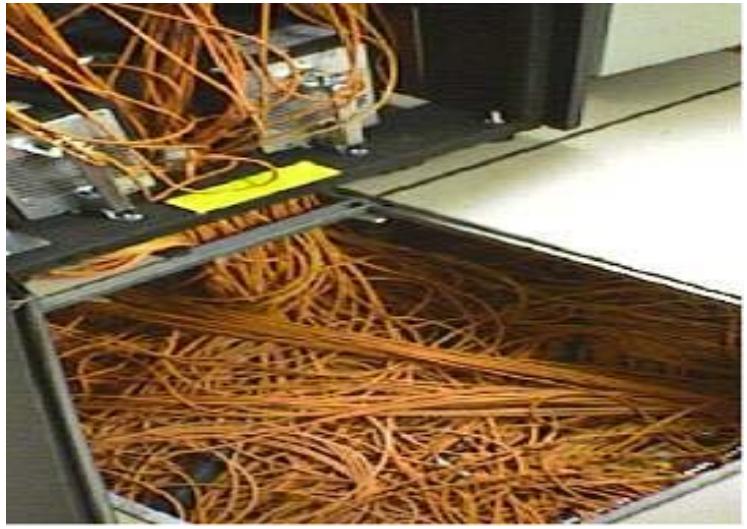
System z delivers all these capabilities today!

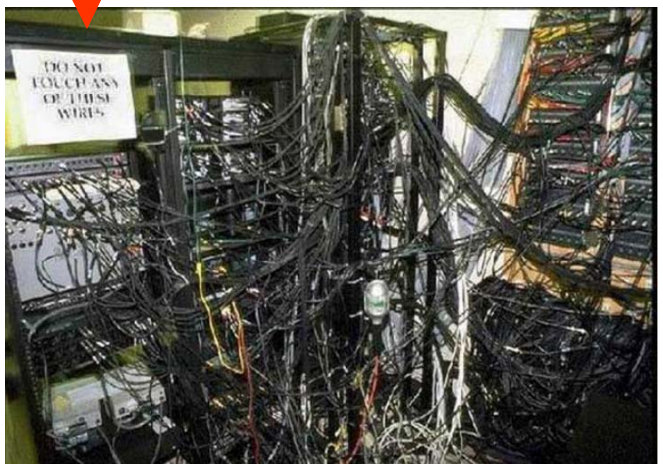
IBM

Complexity Is Growing

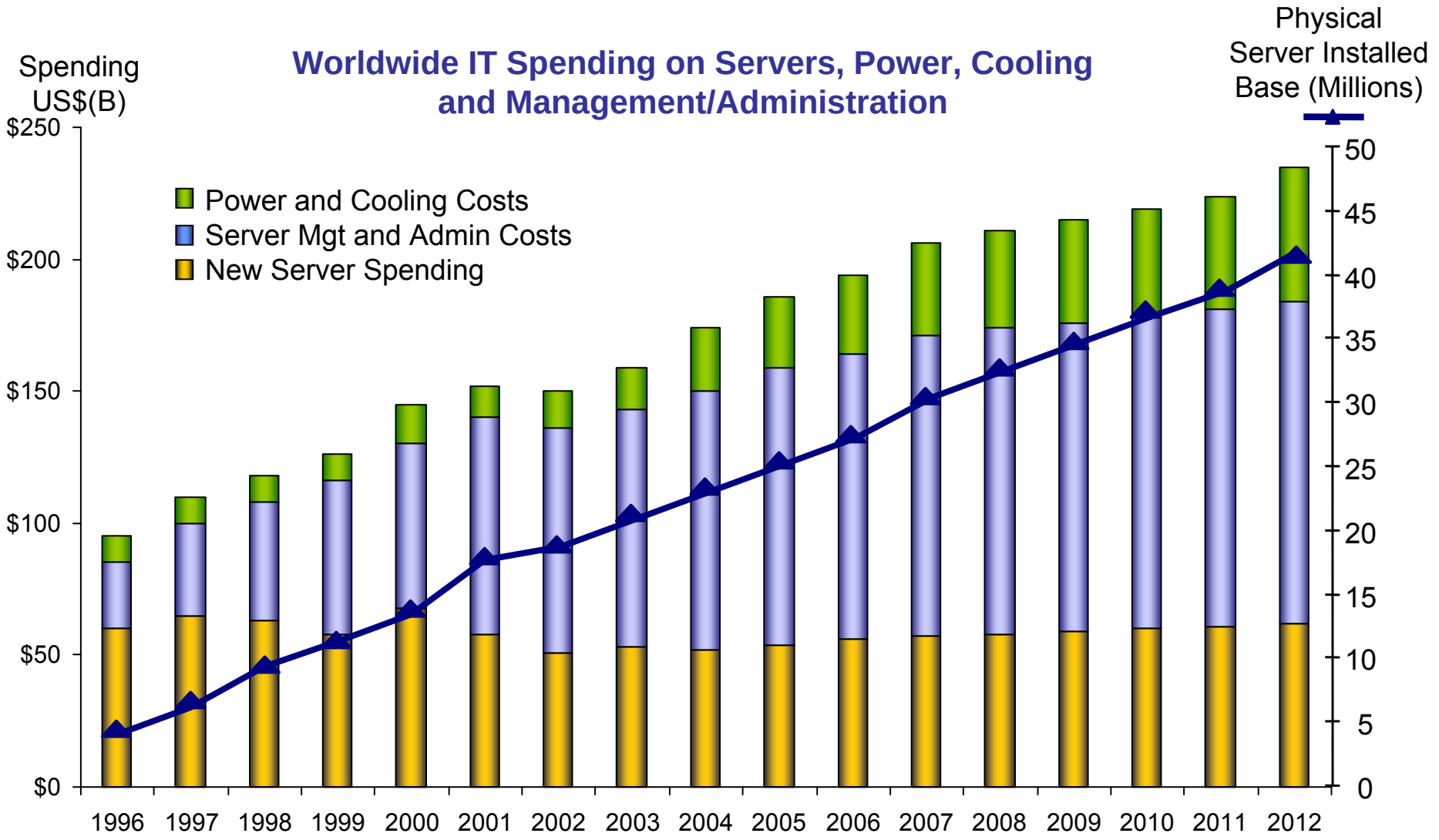


- Complexity drives cost
- Reduces responsiveness
- Likely to impact security and performance





Annual Operating Costs Are Out Of Control

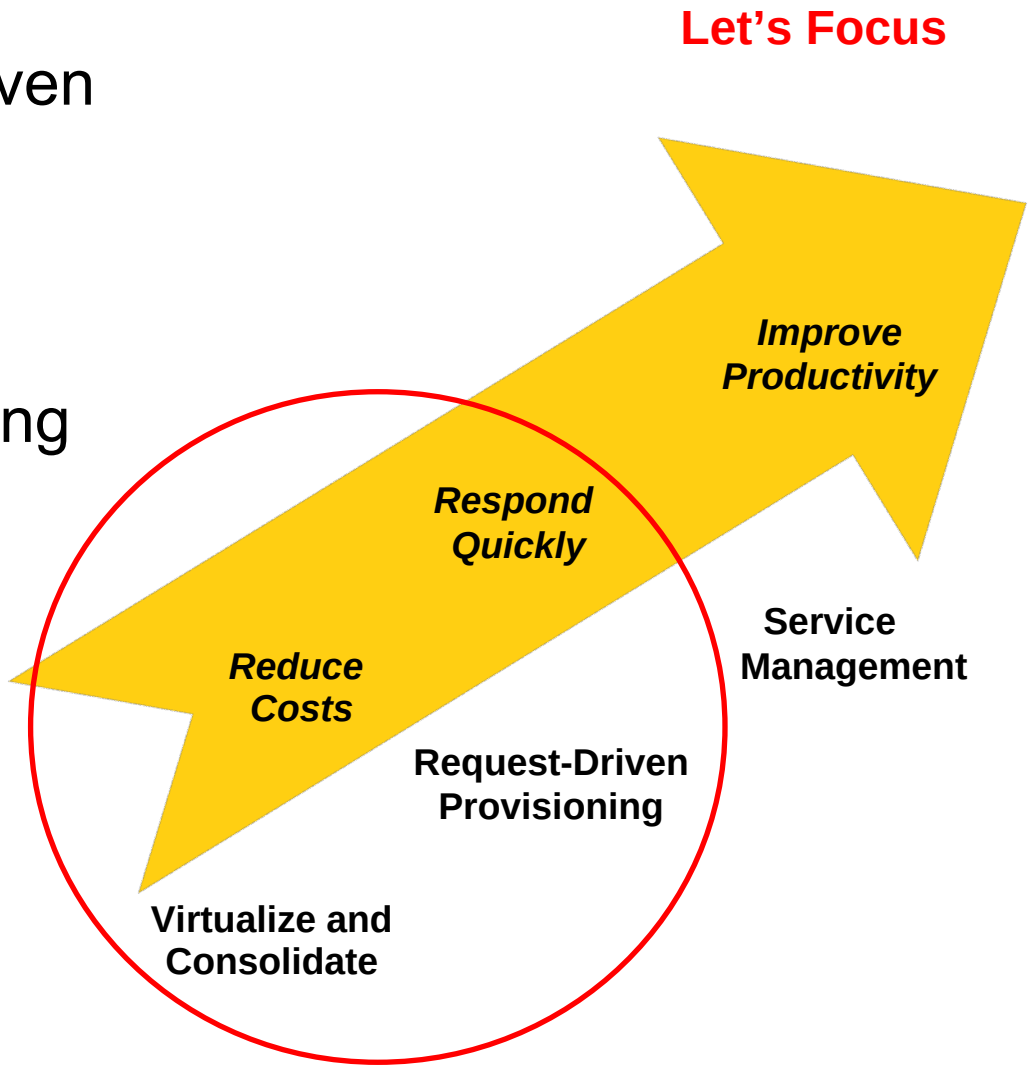


IDC, 2008

Dynamic Infrastructure For A Smarter Planet

- Virtualization and Consolidation is a proven way to save money

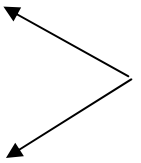
- Request Driven, or Automated, Provisioning increases agility and lowers labor costs



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

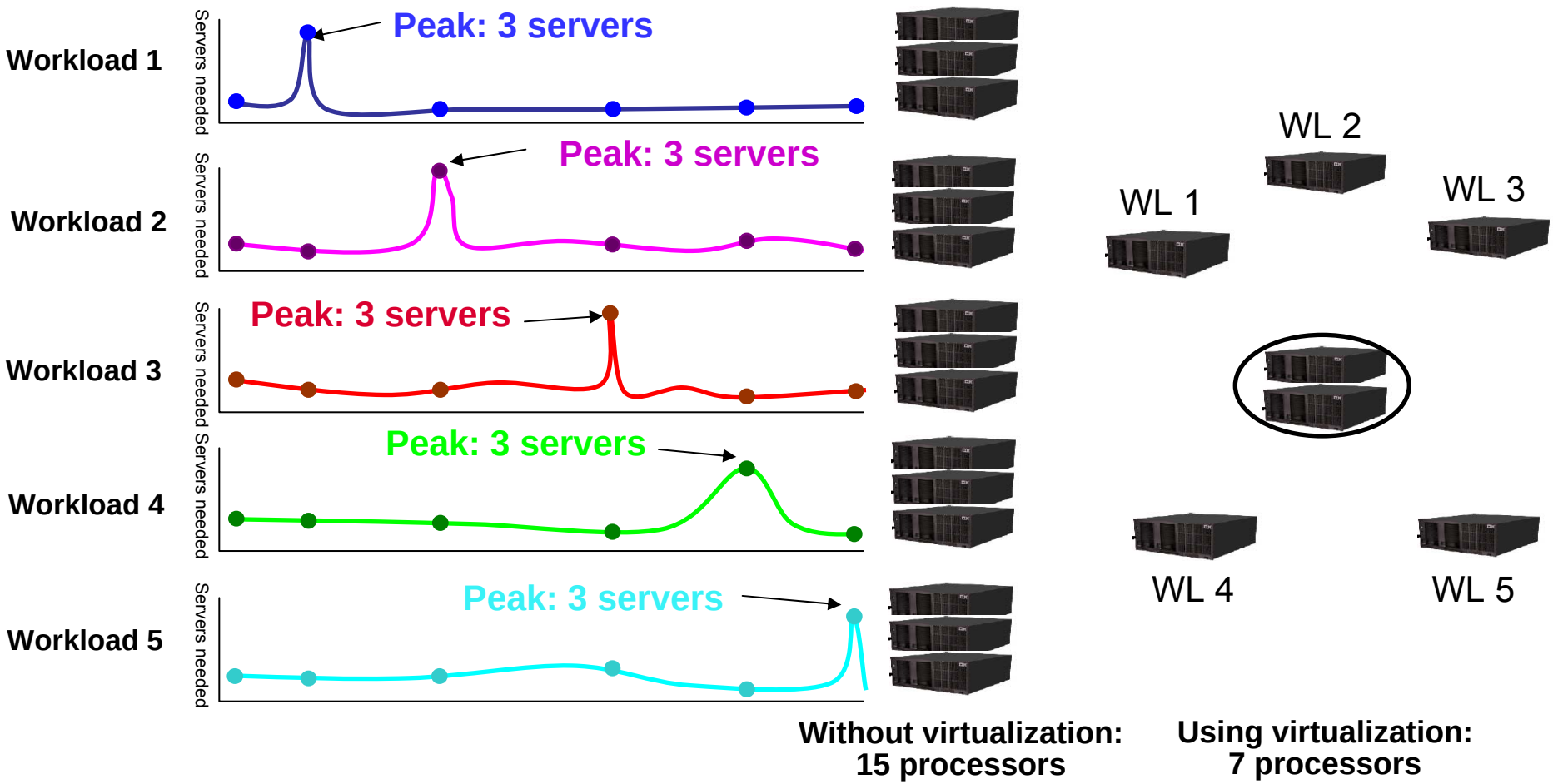


Needed: Something that works on these

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

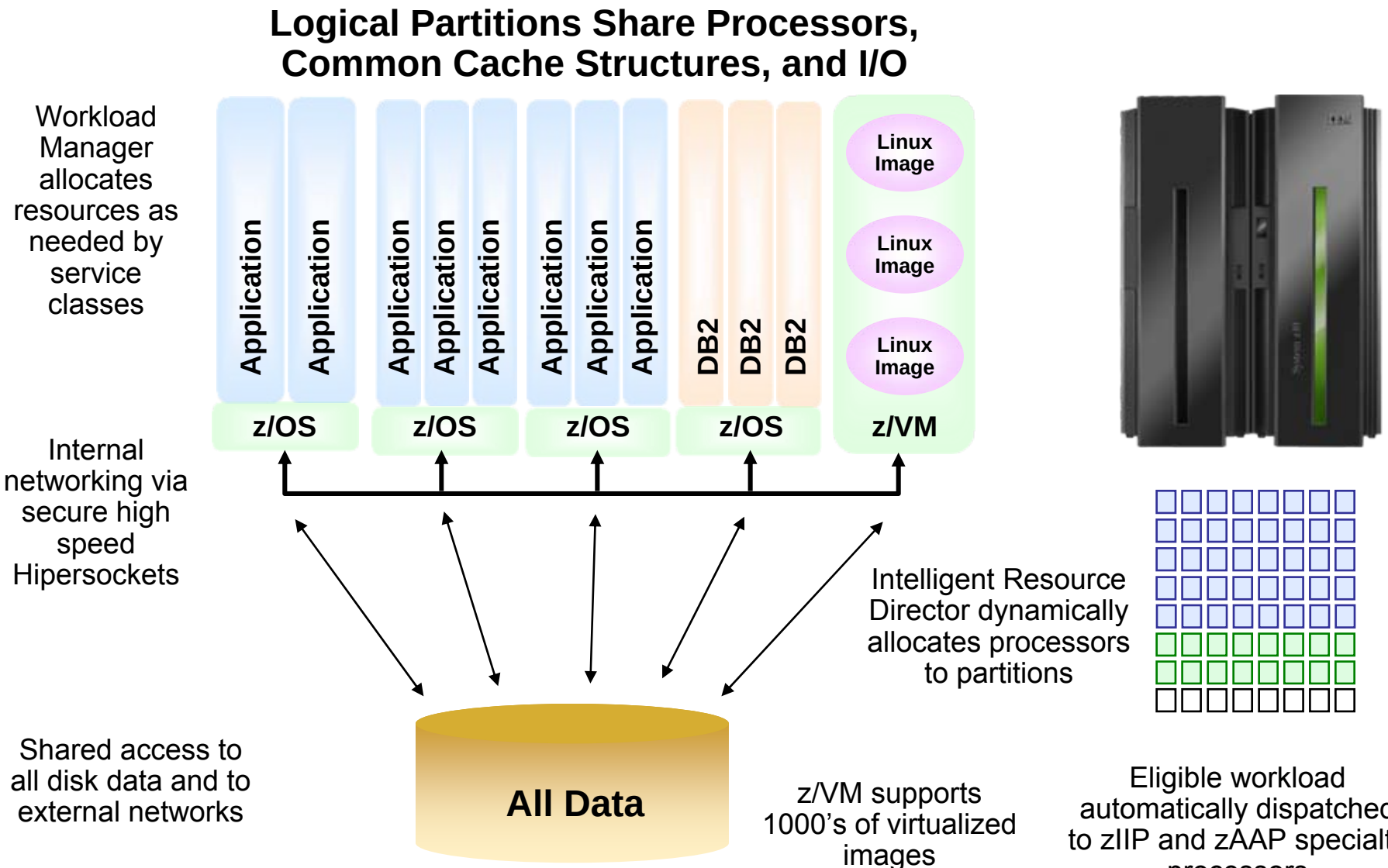
Source: IBM internal study

Example:
Improve Efficiency And Reduce Costs



What's Required: Virtualization and intelligent workload management to accommodate shifting workloads.
But this is automatic on the mainframe!

System z Is Designed For Extreme Virtualization



Linux Server Consolidation On System z Takes Cost Out Because…

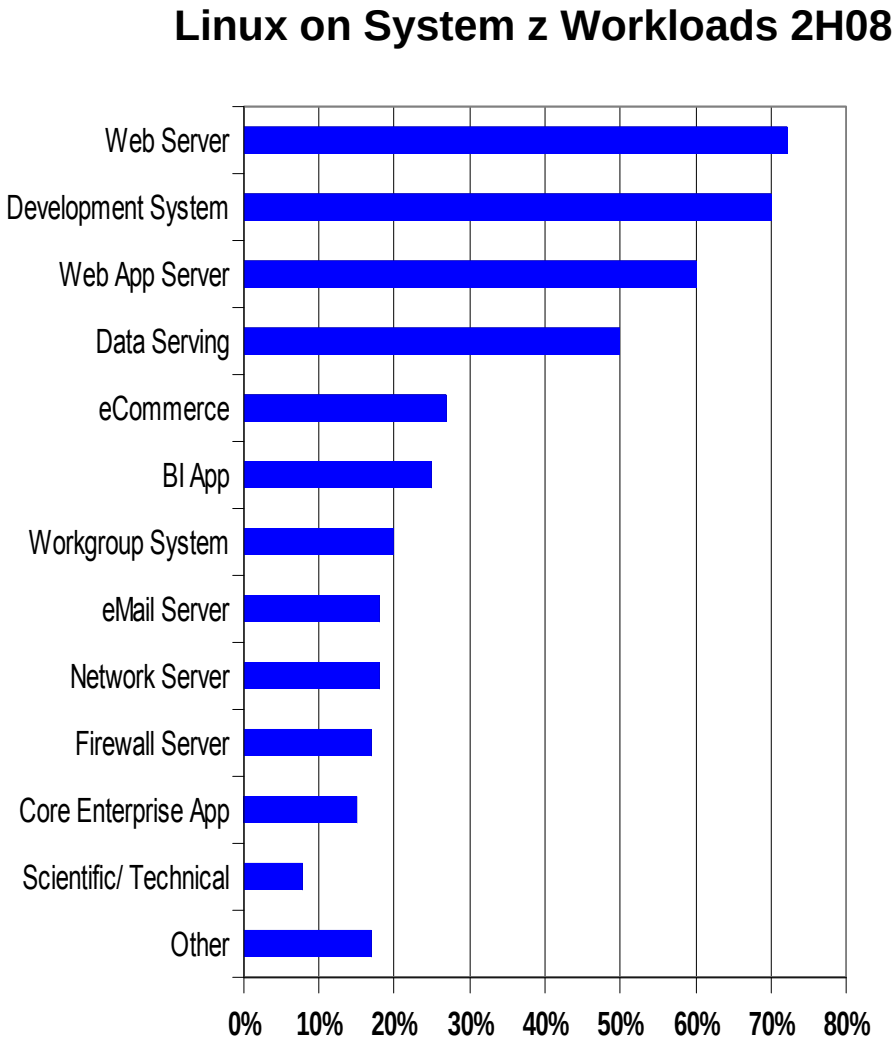
- System z IFL processor is deeply discounted
- IBM (and many other vendors) only charge per IFL processor fees for software, not per image
- Consolidation reduces most other annual operations costs
- Simplify networks by removing physical implementation
- Benefit from System z virtualized storage and 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

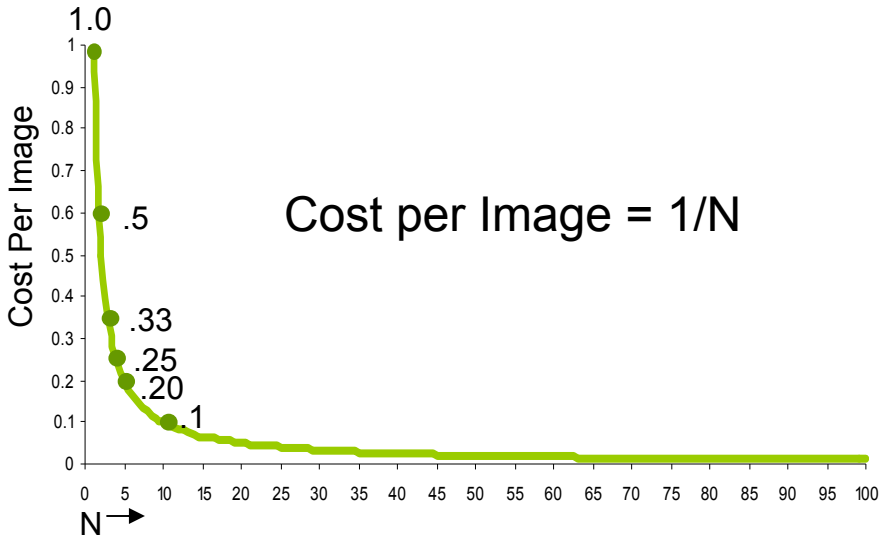
Linux Workloads On System z

- 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



How Much Money Can You Save?

- Costs shared by all “N” consolidated images
  - Hardware
  - Software
  - Power
  - Floor Space
  - Local Network Connectivity

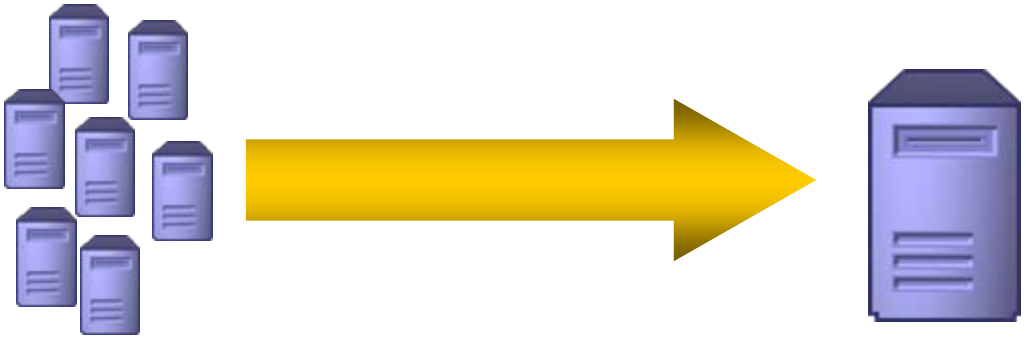


- Costs not shared by consolidated images
  - Migration cost per image — Fixed cost per image
  - Off premise network cost
  - Labor cost per image — Fixed cost per image, but typically less than unconsolidated labor cost

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?



Ratios

$P_R = P_B / P_A$

$U_R = U_B / U_A$

$C_R = C_B / C_A$

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

Processor Performance Ratio

Processor Utilization Ratio

Cores per Frame Ratio

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

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

This theoretical maximum assumes a worst-case scenario where all workloads peak at the same time

Identify Consolidation Opportunities

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

	P_R Performance Ratio	U_R Utilization Ratio	C_R Core Ratio
Servers that are candidates to be consolidated	Older servers with slower processors	Servers with low utilization	Servers with a low number of cores
Servers that are best consolidation platforms	New servers with faster processors	Servers that can achieve sustained high utilization	Servers with a high number of cores
Typical Ratios	**1.0 - 3.0**	**10 - 20**	**1- 64**

Maximize N!

The more servers you can consolidate, the more money you will save

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

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

- Efficiency (e) of the platform hypervisor can reduce the consolidation ratios achievable, because **e < 100%**
  - Different efficiency in each major dimension
    - CPU utilization
    - Memory footprint and over-commit overhead
    - I/O demand
- Service Level Agreements set further thresholds
  - Random variability of workloads
  - Response time norms and maximums

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 workloads on the mainframe provides the best economy of scale. Let's see why!

IBM

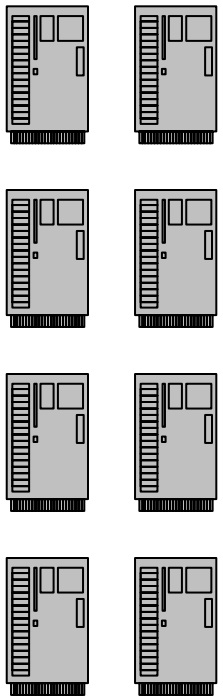
A Benchmark Comparison

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
12 GB memory

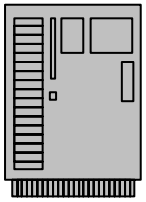
Workload for each server:
5% utilization
40 ms response time
4.5 tps



Case 1: Consolidate to z/VM

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

Case 2: Consolidate to VMware



Intel server x3950
8 cores @ 3.5 GHz
64 GB memory

Existing non-virtualized workload on older servers

Consolidate VM images on two different platforms

Each VM image run on
4 virtual cores
1 GB virtual memory

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
  - From observed customer results, these numbers made sense:
    - Linux on System z – maximum **85%** utilization
    - VMware/Intel platforms – maximum **50%** utilization

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

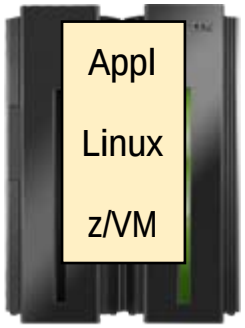
Existing Mainframe

Existing processors:
4 general purpose

Existing 245 Standalone Servers

8.75 servers to 1 IFL core

Add LPARs for Intel Server Consolidation



Add 28 IFL cores:

Or maintain existing 245 machines in Intel server farm

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

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

Mainframe Incremental Hardware

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)

Mainframe Software

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

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

Dedicated Software

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)

Mainframe Incremental Hardware

OTC		ANNUAL	
28 IFL Processors	$3,500,000	Power/Space	$16,884
		Hardware [1] Maintenance	$490,224
RAM (160GB)	$960,000		
Inc. Disk Acq.	$412,403	Systems Admin	$551,651
Migration	$4,128,495	Disk Maintenance	$11,856
TOTAL	$9,000,898	TOTAL	$1,070,615 (y 2-5)

Mainframe Software

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

VMware Hardware

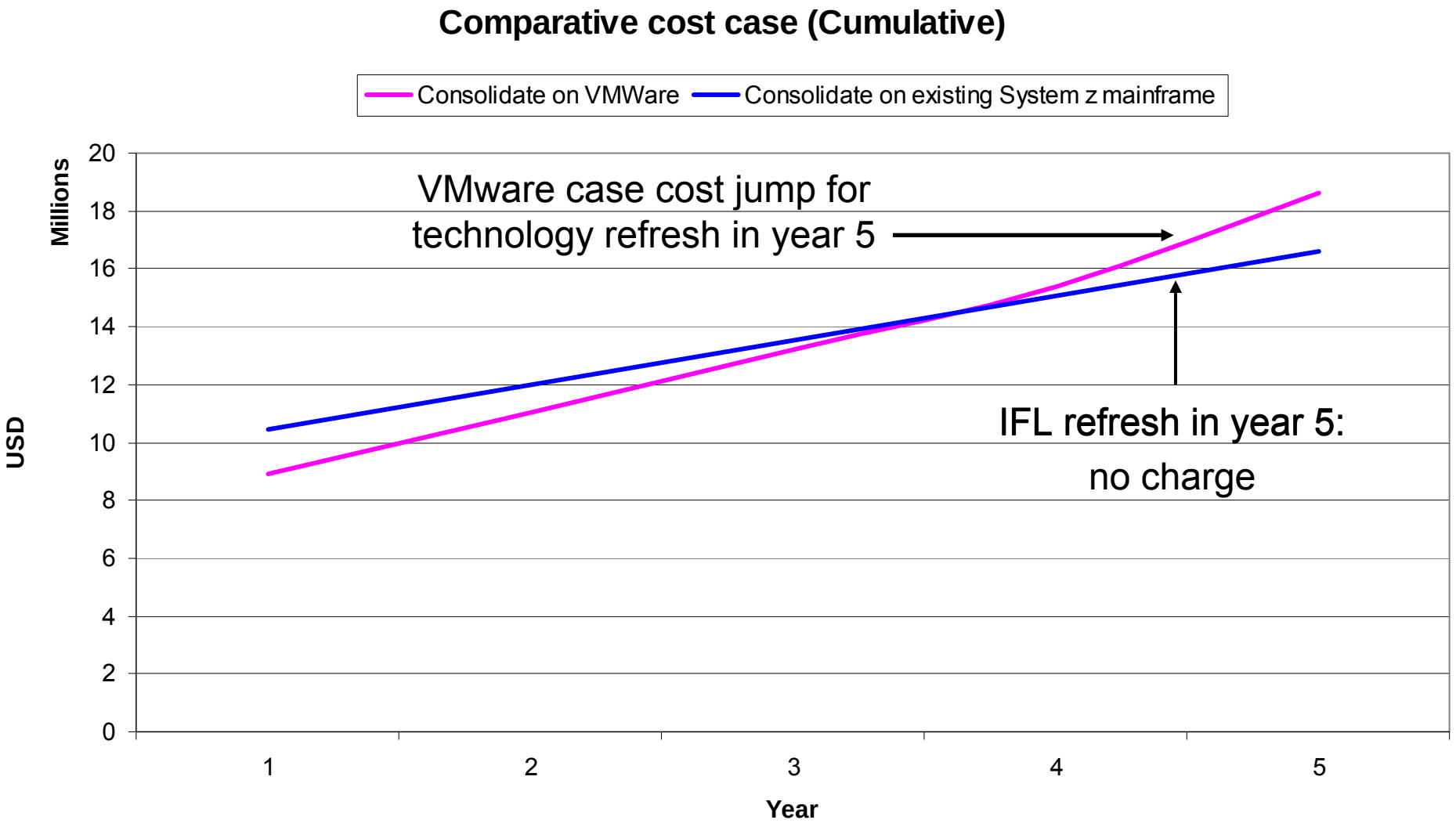
OTC		ANNUAL	
New Servers	$1,087,485	Power/Space	$44,121
Tech Refresh (yr 5)	$1,087,485	Hardware Maintenance	Paid in acq.
Disk Acq.	$744,432	Systems Admin	$1,614,393
Migration	$4,541,345	Disk Maintenance	$31,872
TOTAL	$7,460,747	TOTAL	$1,690,386

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 (y 2-5)

[1] First year maintenance free

VMware TCO Result



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 capacity on demand) **widens the gap** when DR is included
  - 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 workload of 100's of 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 …
Competing HW infrastructure	Sun SPARC (e10K, v440, 280R)	z10 EC
Footprints	Tens of machines	1 machine
Cores / Memory	131 cores* Thousands of GB	3 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) Heat (kBTUs/hr) Space (racks) CO2 (tonnes)	 36 kWhr 110 kBTUs/hr 6.5 racks 66 tonnes	 22 kWhr -> 38% less 74 kBTUs/hr -> 33% less 4.5 racks -> 31% less 40 tonnes -> 39% less

Summary of Benefits:

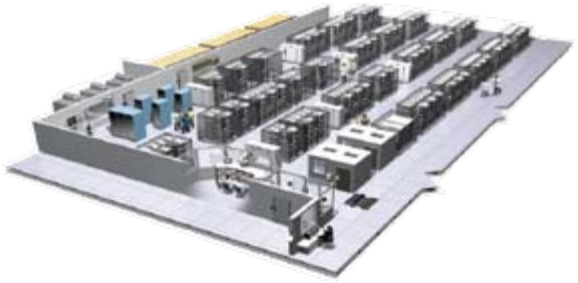
- **Maximize space, keep costs down and reduce carbon footprint**
- **Boost the speed of new deployments**

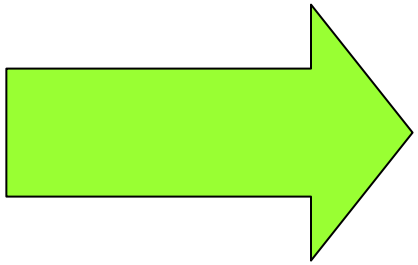
*Customer estimate

Server Consolidation and Migration Services Offering – May 2009 – NEW

Initiative to make it easier for Sun and HP Customers to join the move to IBM System z

- Dramatically reduce the time/effort in migrating applications
- Based on IBM's own server consolidation experience
- z Rewards
  - Customer financial incentives to take advantage of these services

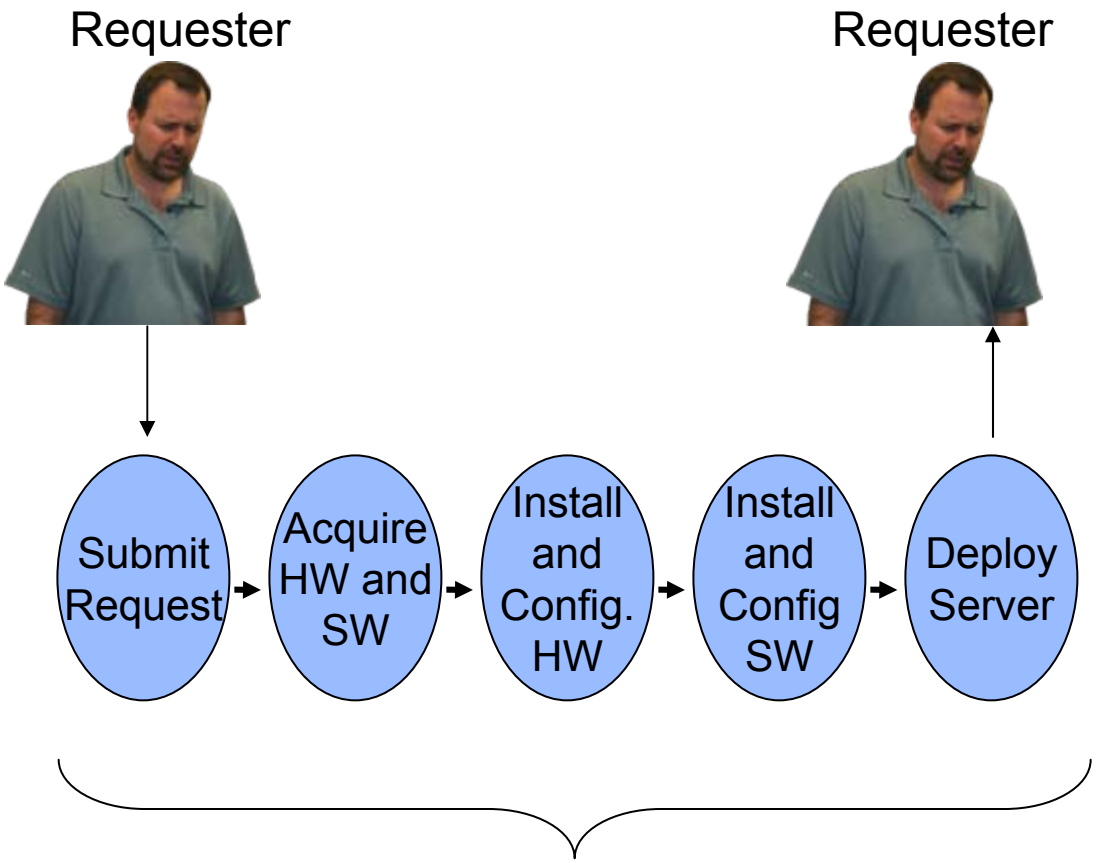




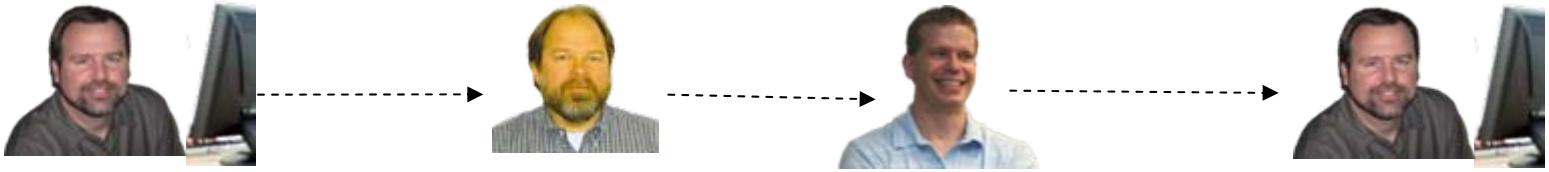
Deploying New Applications And Services Is Difficult And Time-Consuming

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

Service Oriented Finance CIO



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

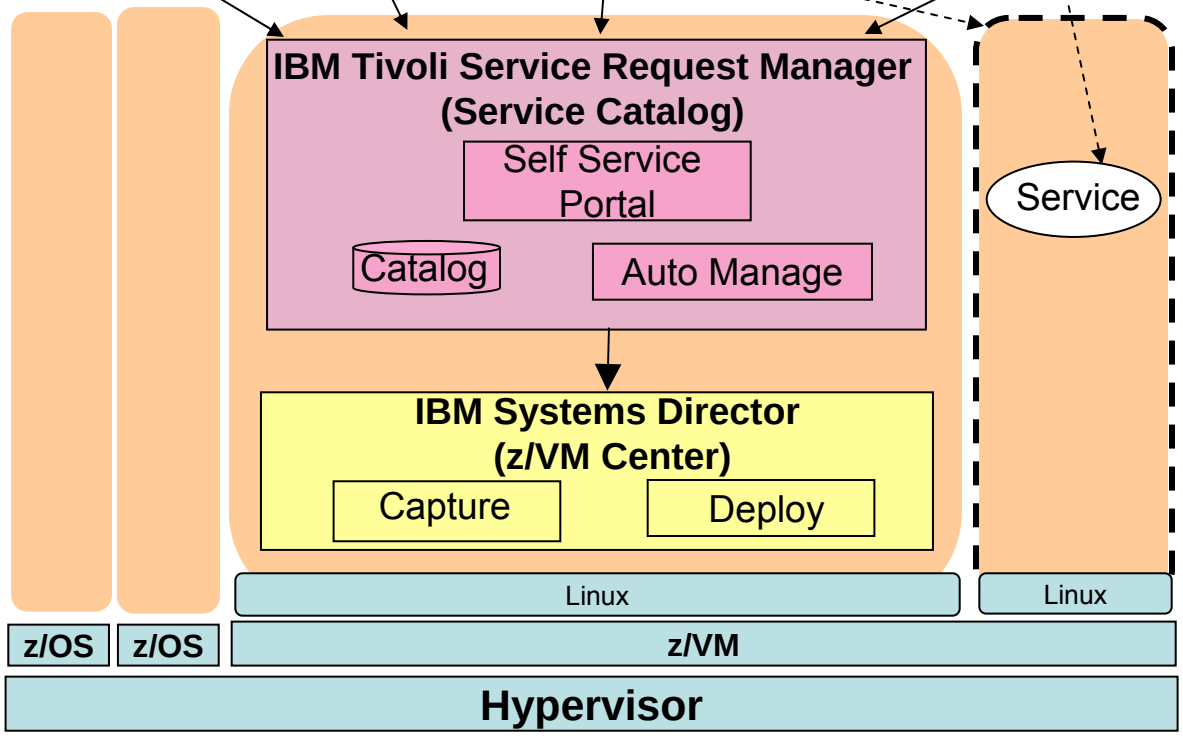


User browses through the service catalog, adds service to his shopping cart, submits request

Request Approved

Request Fulfilled (implemented with z/VM Center)

User gets notification of his requested service being ready



Tivoli Service Request Manager (Service Catalog)

User browses through the service catalog, adds service to his shopping cart, submits request

Request Approved

Request Fulfilled

User gets notification of his requested service being ready

Service Catalog

Self service portal and catalog

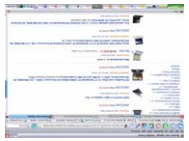
- Structured, searchable, database of services available to end users
- Add orders to shopping cart and checkout

Auto manage order approval

- Order authorization and approval

Auto manage order fulfillment

- Automated provisioning of services
- Workflow management of manual process steps



Auto manage user notification

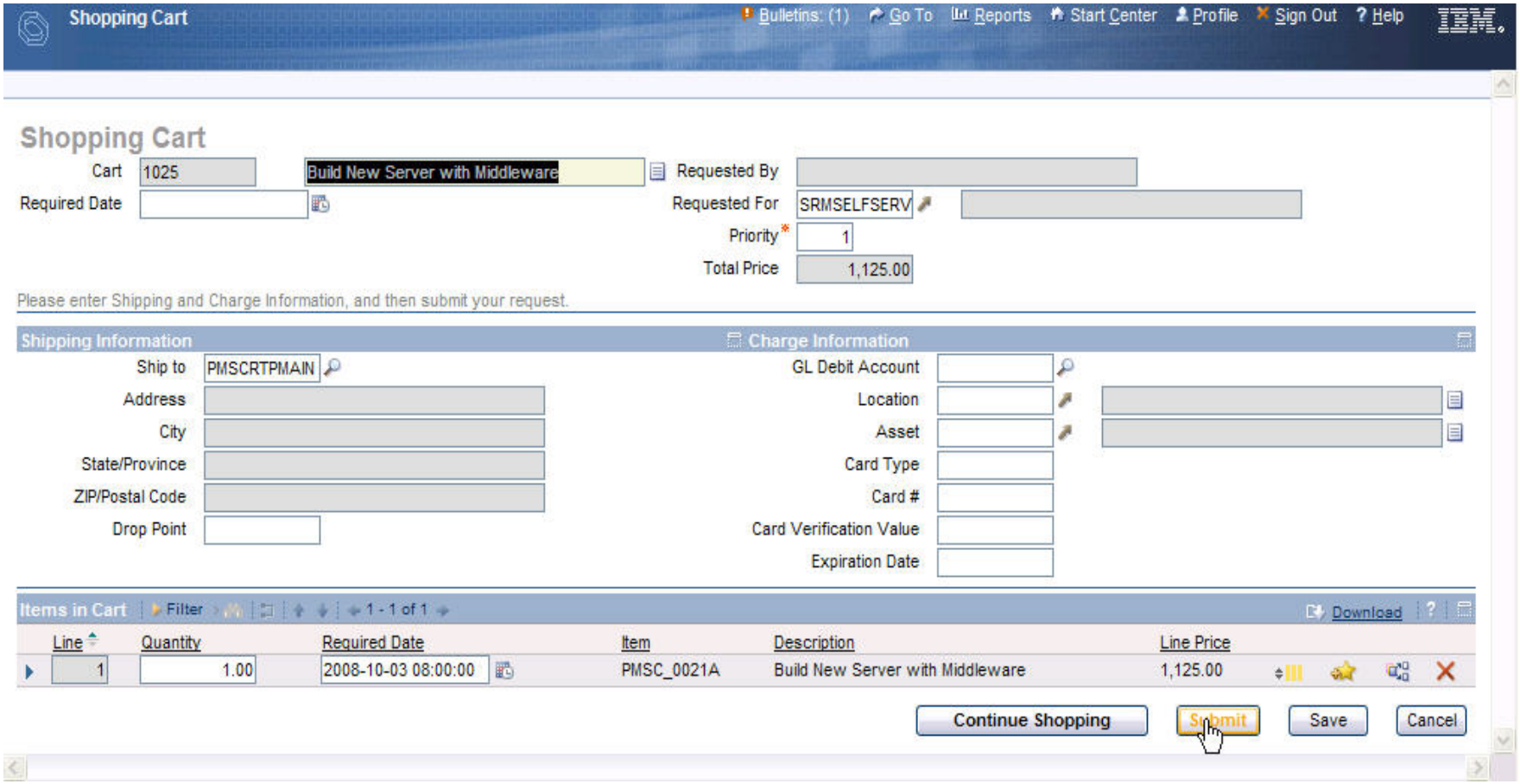
- Automatic notification to users of service being ready

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



Value Of Automated Provisioning

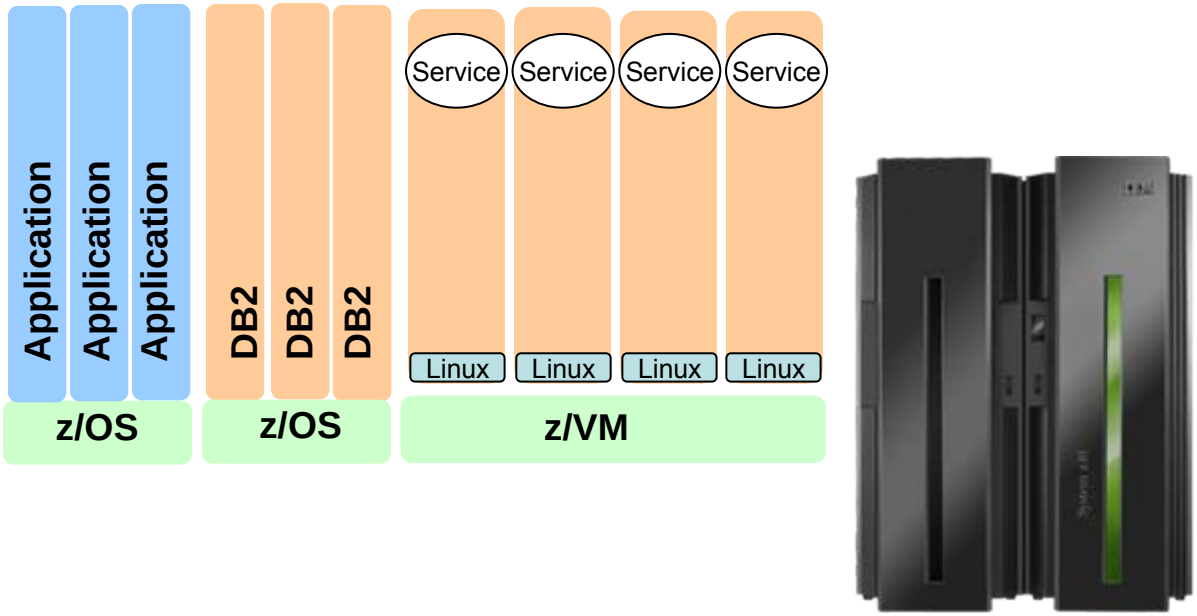
- Automation reduces the labor (time and effort) required
- Time to initial deployment is reduced
- Better image control yields improved stability of systems
- Consistent configurations between test and production minimizes differences across environment
- Critical updates (security, stability, performance) 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 **T**ake **C**osts **O**ut.

Start a project now !

IBM