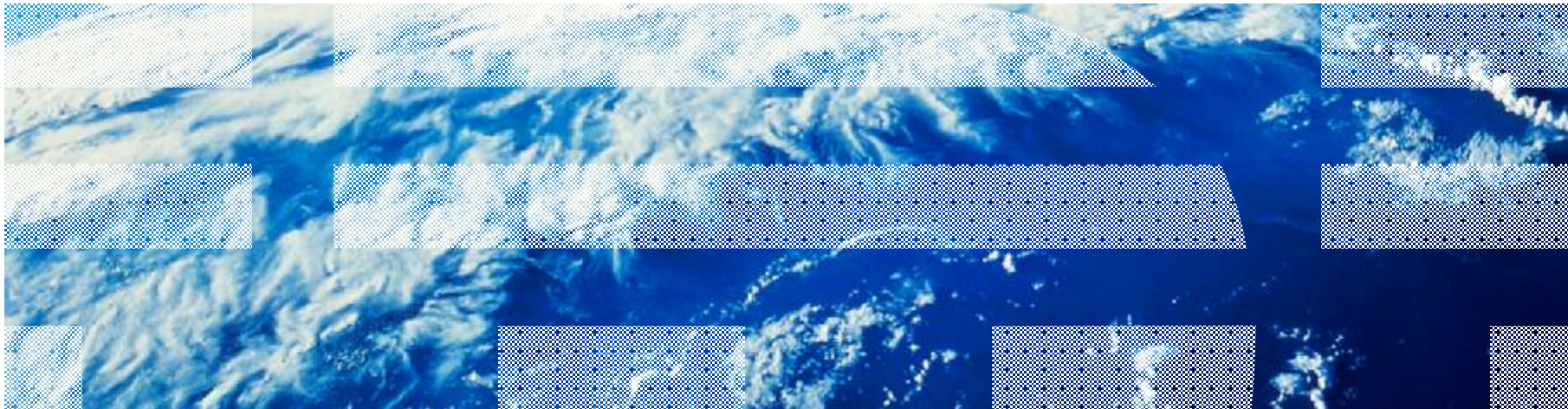


# Linux auf System z: Lösungen für Ihr Rechenzentrum



## Agenda

§ The environment today

§ Competitive virtualization study

- A benchmark comparison
- Service Level Agreements
- TCO comparison

§ Extreme virtualization

## The environment today



Today, many infrastructures are at breaking point:

§ Server sprawl is endemic in many infrastructures

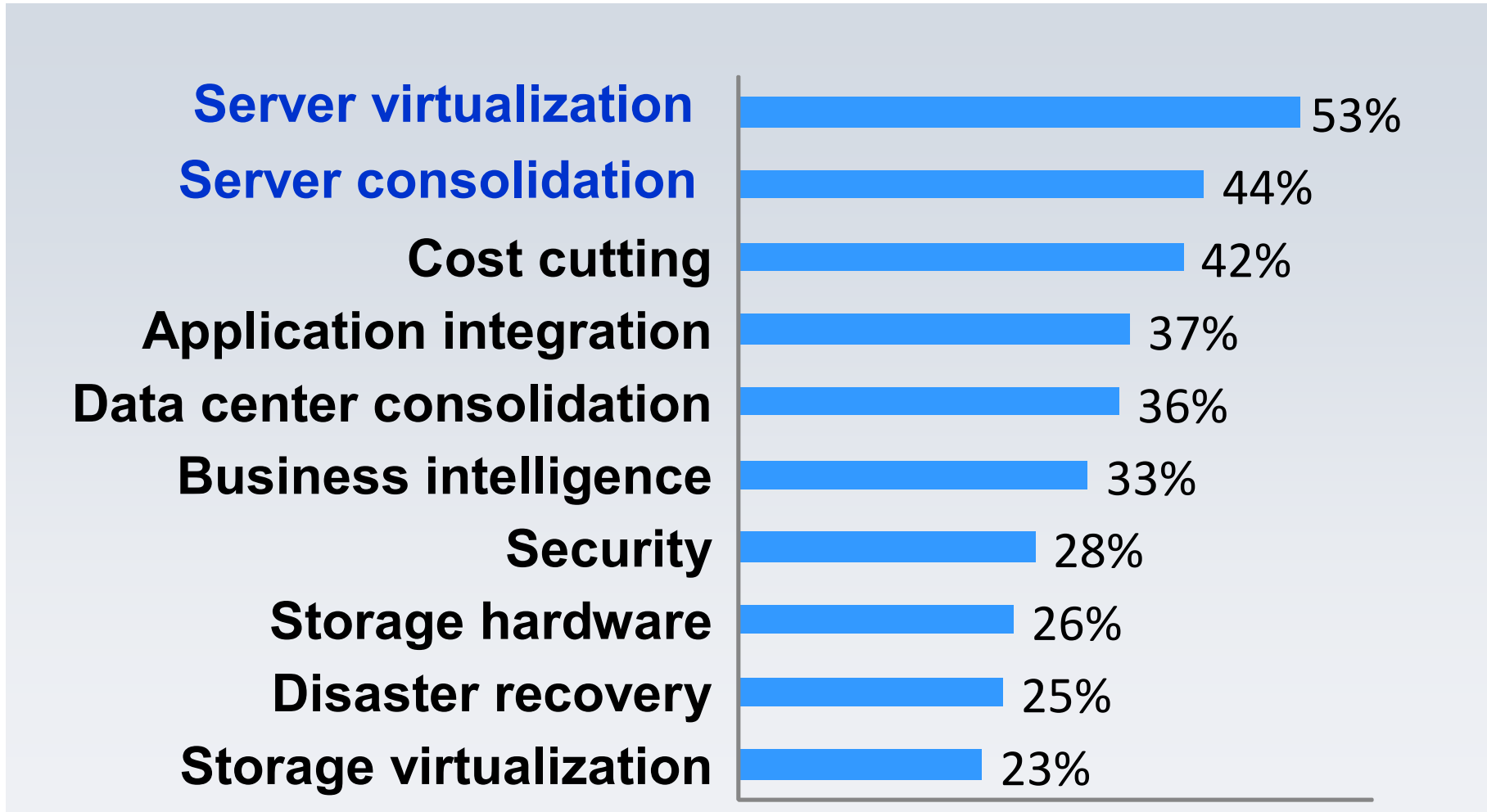
- Costly to manage and run
- Complex to update and modernize
- Space constraint and energy consumption have become key issues

And, older technologies are restricting innovation:

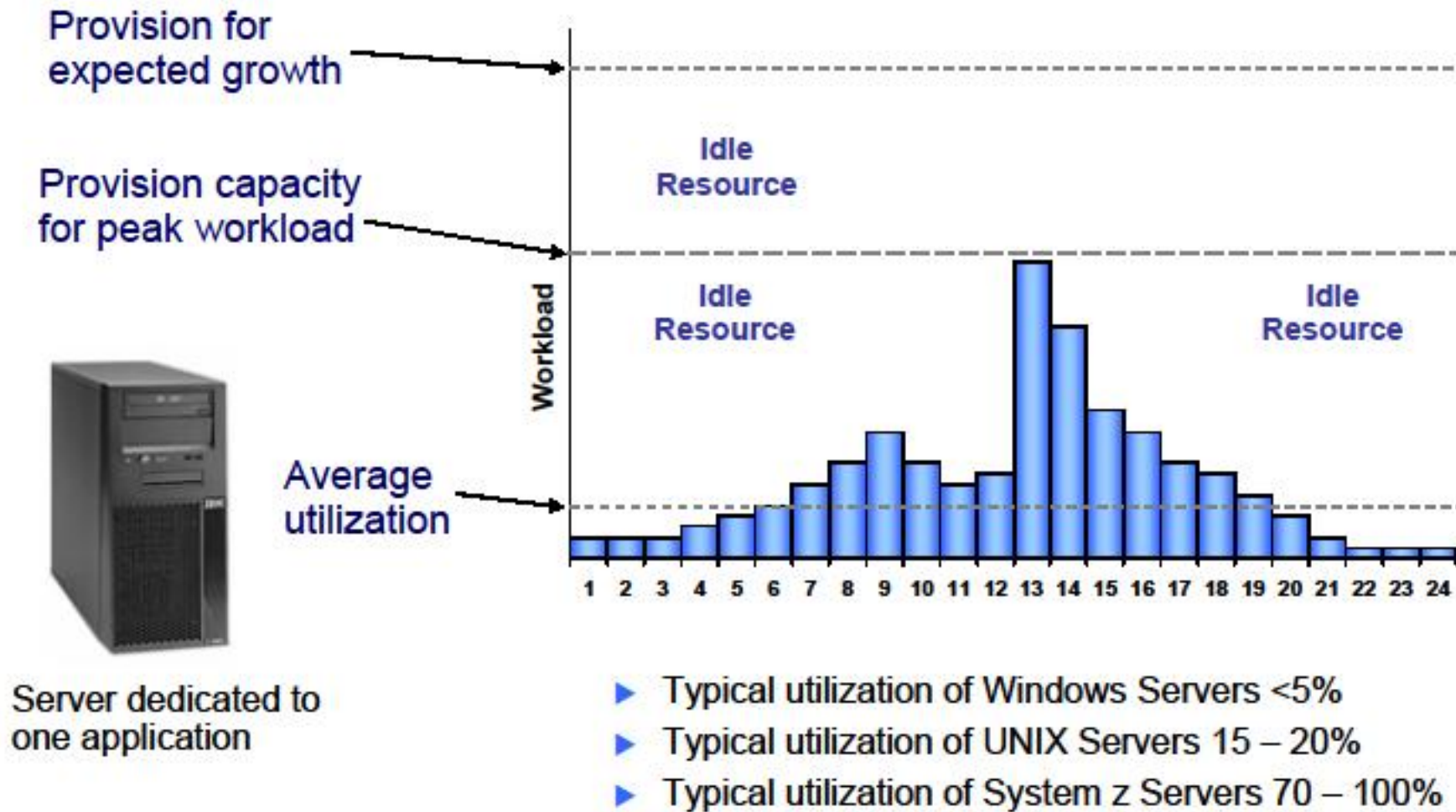
§ Aging and non-strategic technologies

- Increasingly expensive to support and maintain
- Limited new investment from ISVs
- Uncertain technology futures and migrations forced by vendors
- High cost of technology refresh

## CIO Key Spending Initiatives for 2008




## Utilization of distributed servers



## Agenda

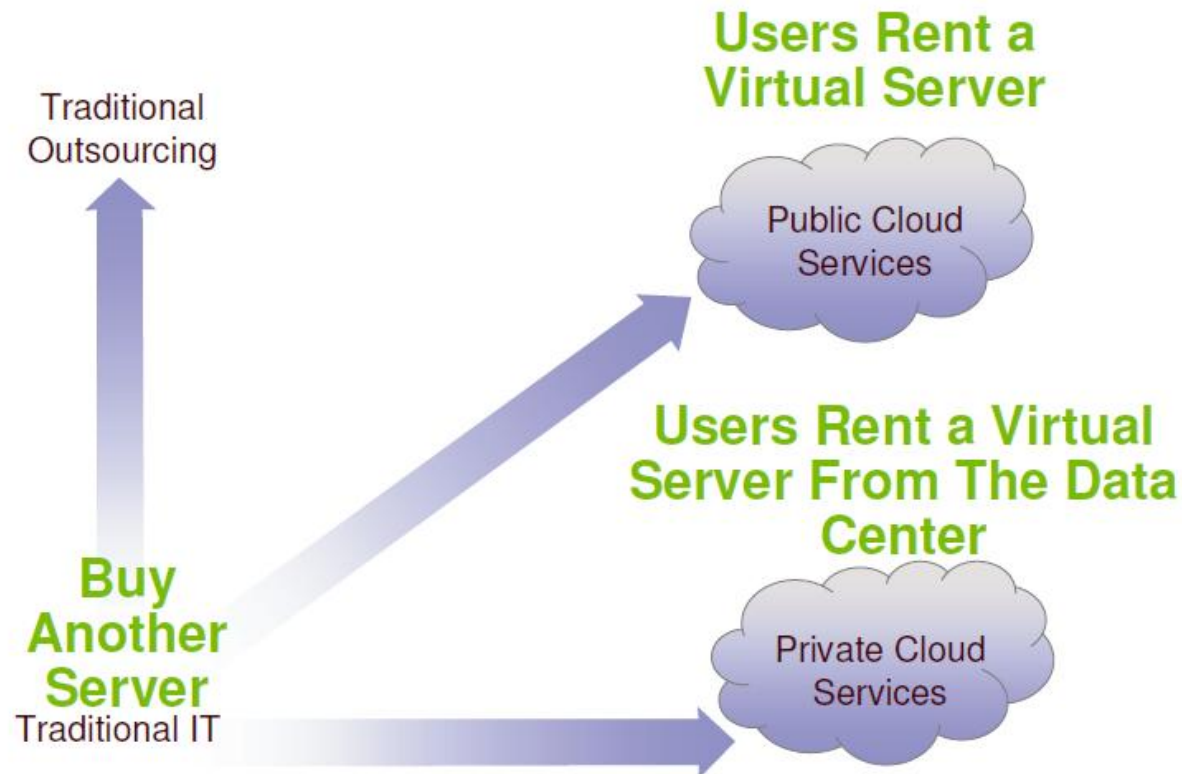
§ The environment today

-  § Competitive virtualization study
- A benchmark comparison
  - Service Level Agreements
  - TCO comparison

§ Extreme virtualization

# Competitive virtualization study – Private Cloud

## Using benchmark data to compare options



### Virtualization Study (July 2009):

Advantages of a Dynamic Infrastructure: A Closer Look at Private Cloud TCO:

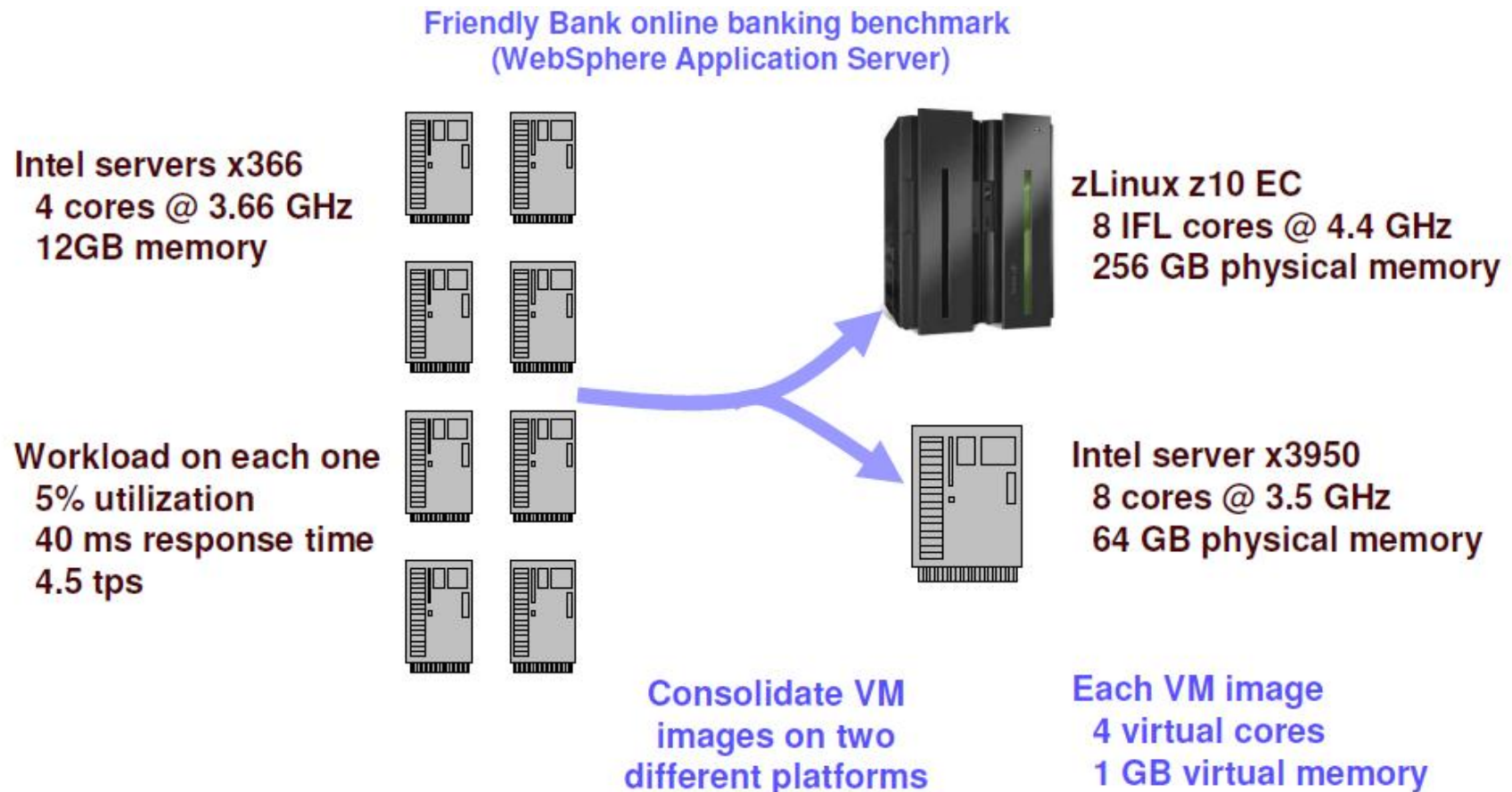
<ftp://ftp.software.ibm.com/common/ssi/sa/wh/n/zsw03126usen/ZSW03126USEN.PDF>

A Benchmark Study on Virtualization Platforms for Private Clouds:

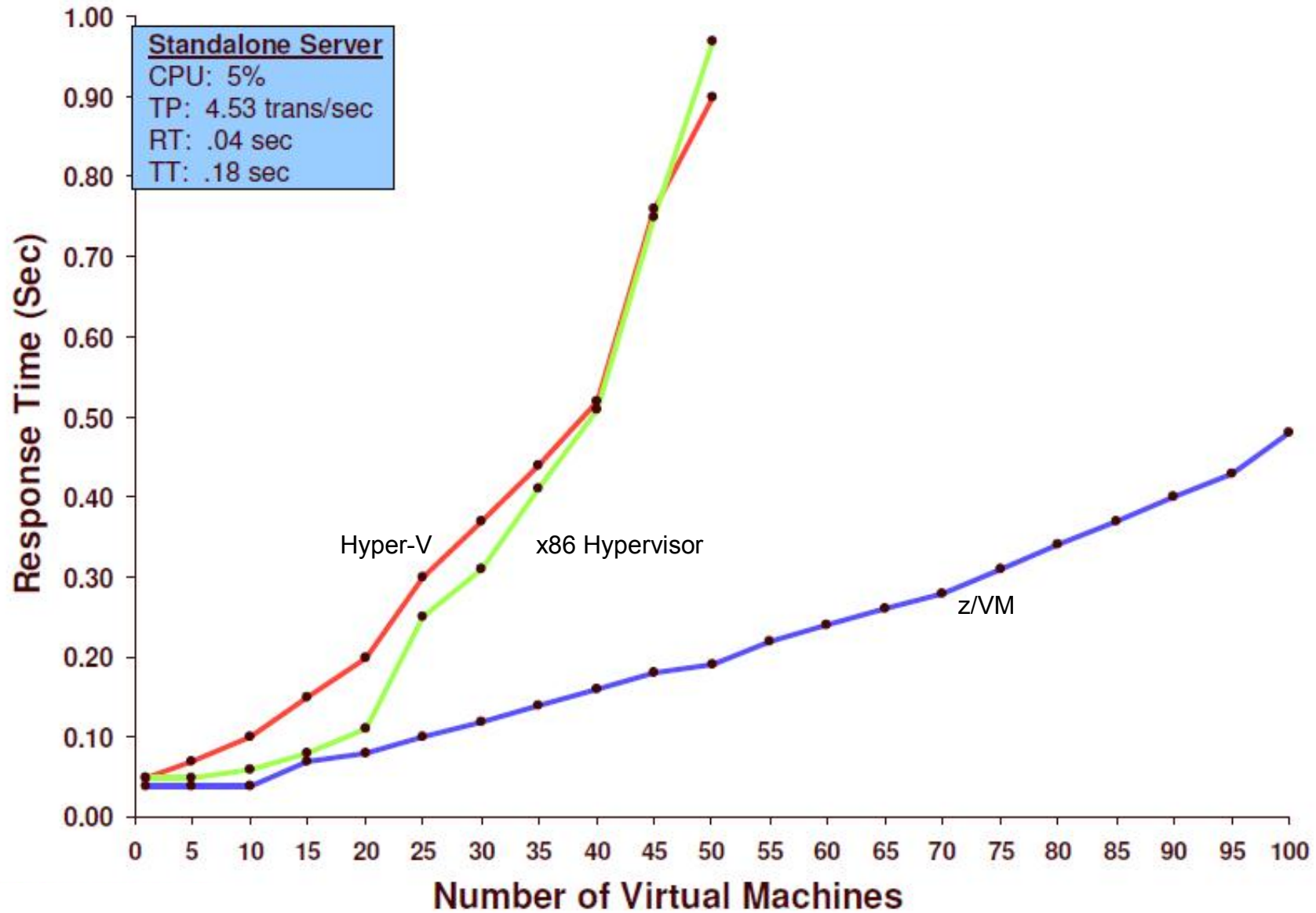
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# How Many Workloads Can Be Consolidated? A Benchmark Comparison

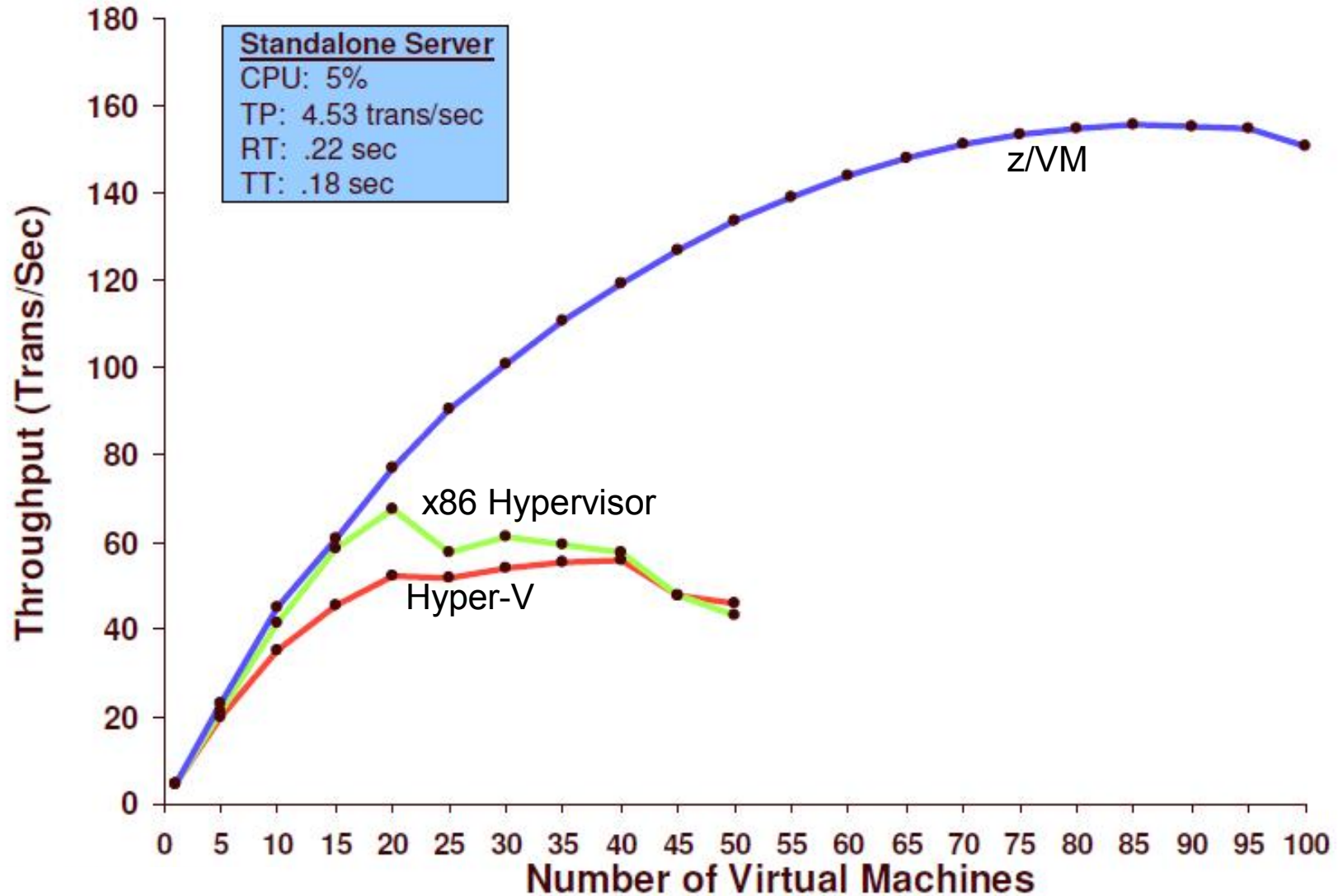
We ran a benchmark to compare how many images can be consolidated in practice



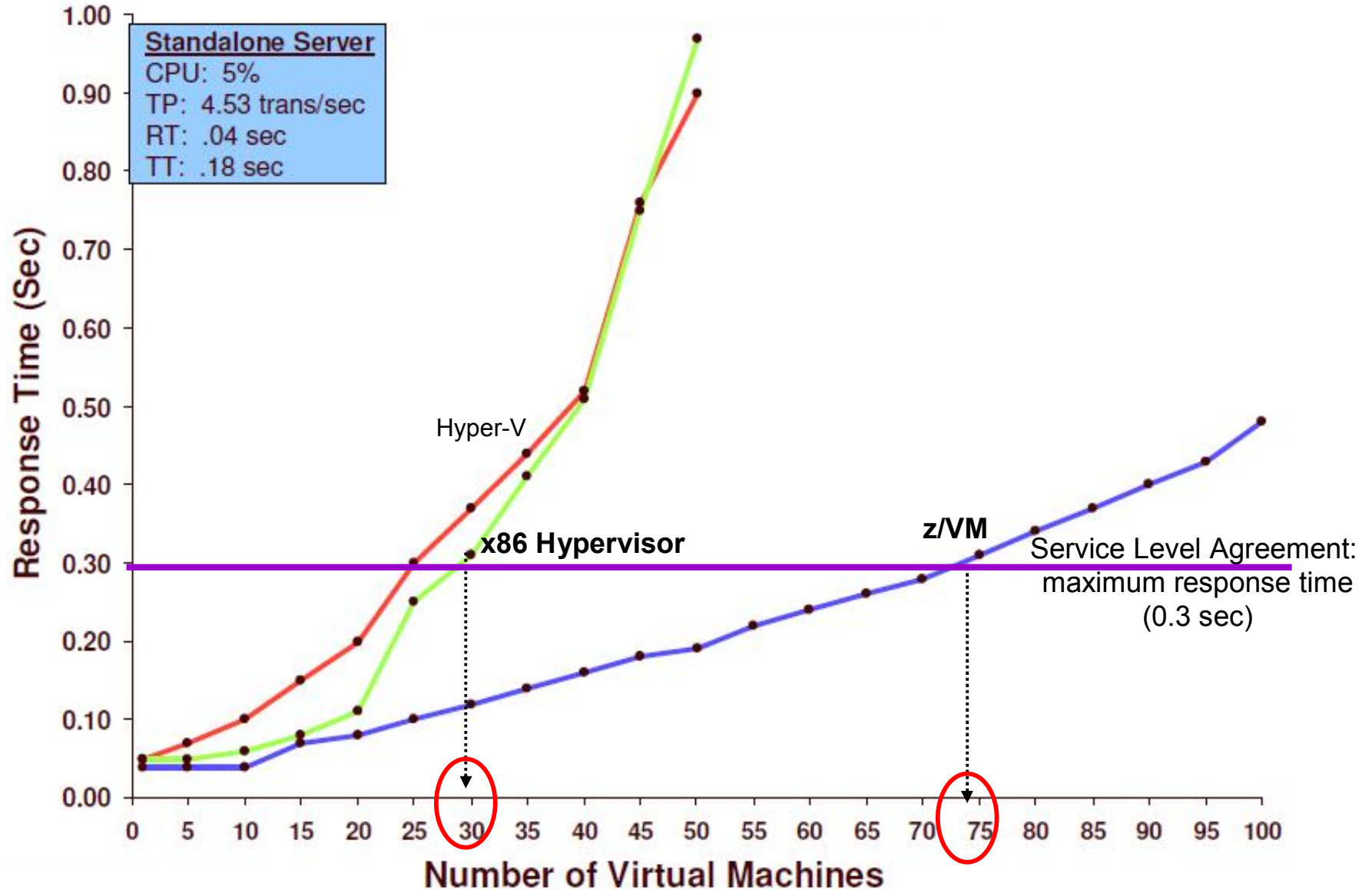
## Response time comparison



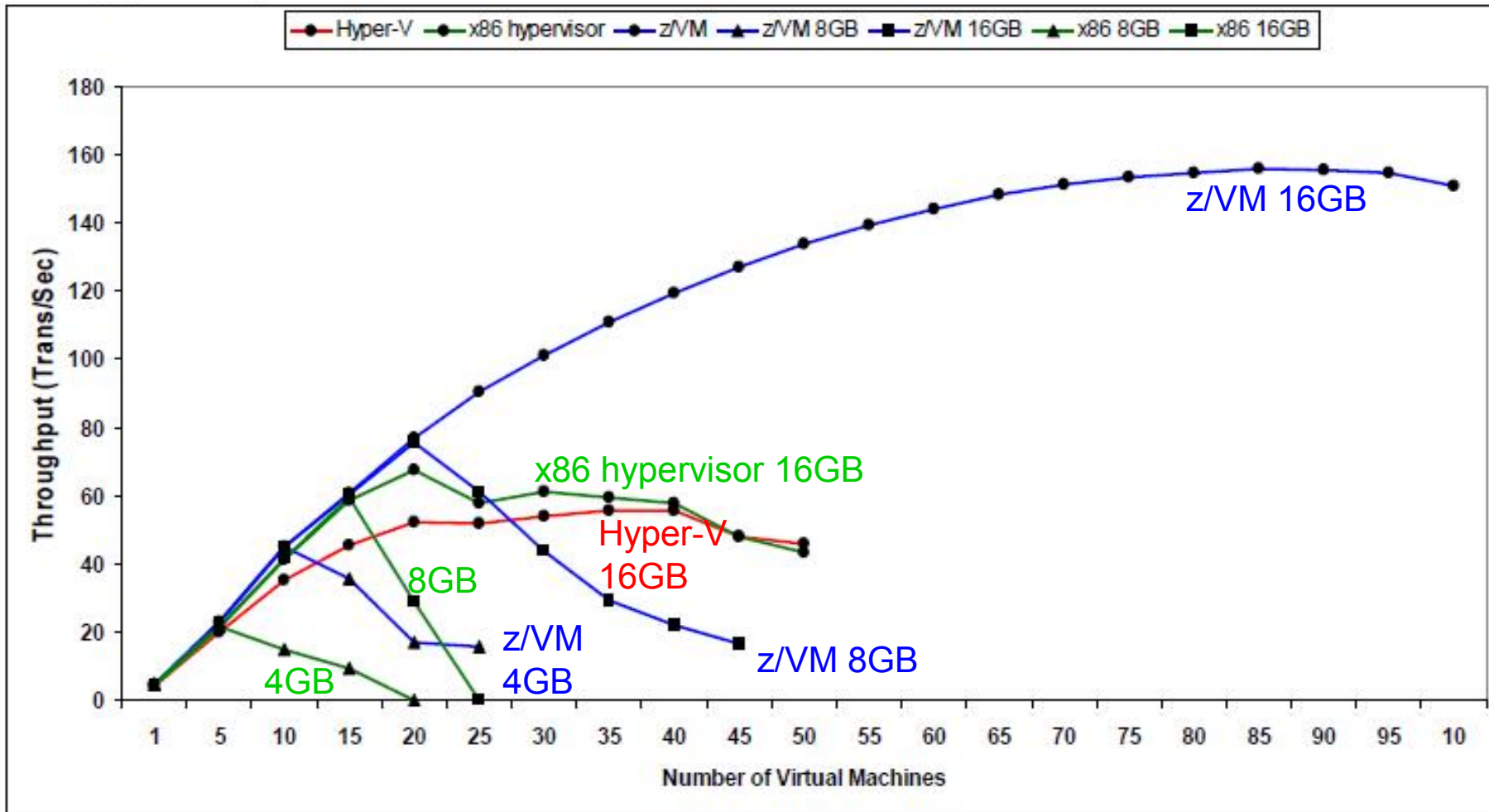
# Throughput comparison



# Response time comparison

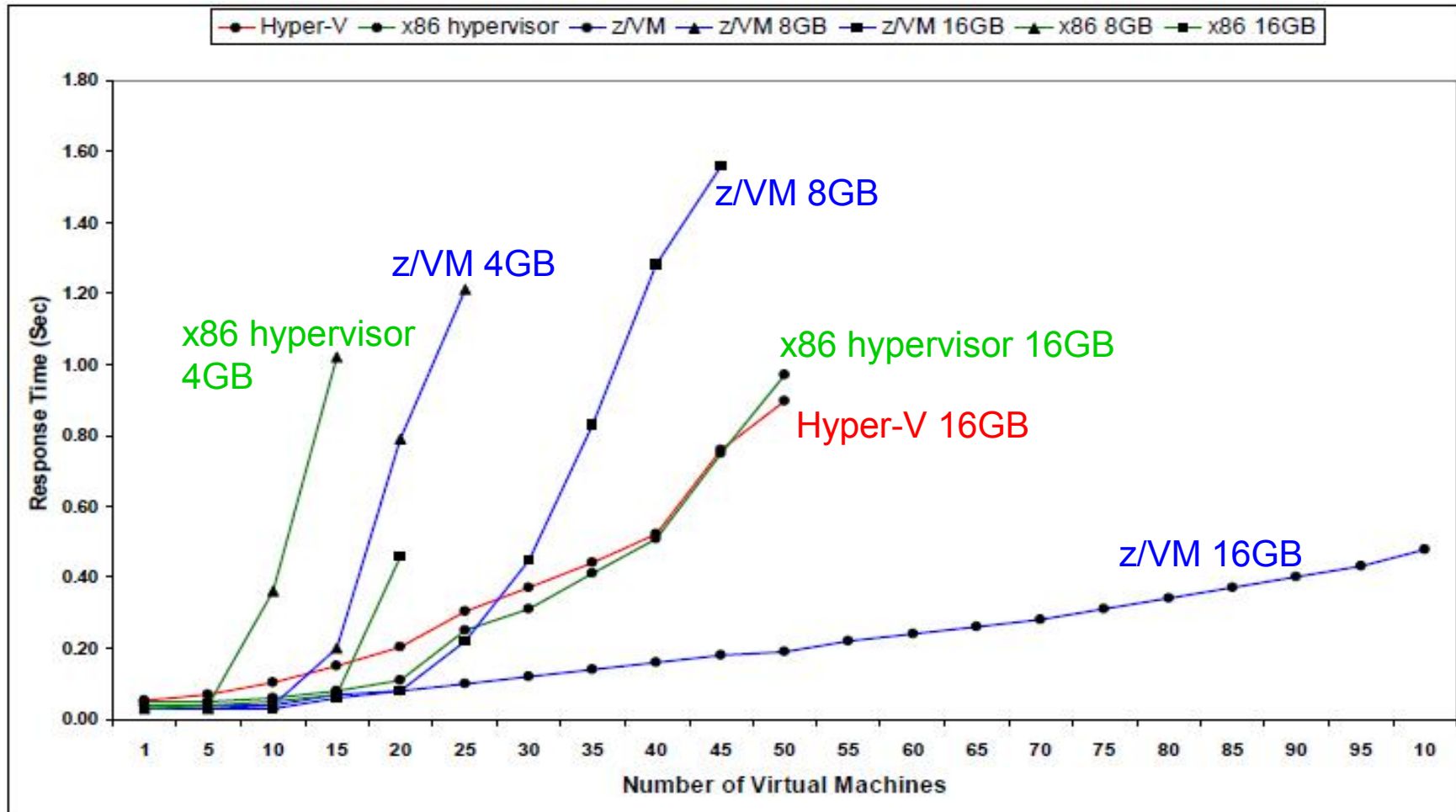


# The effect of memory constraints Throughput



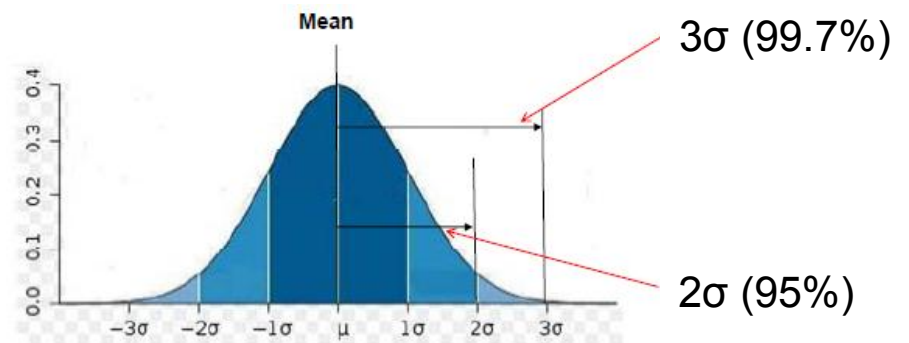
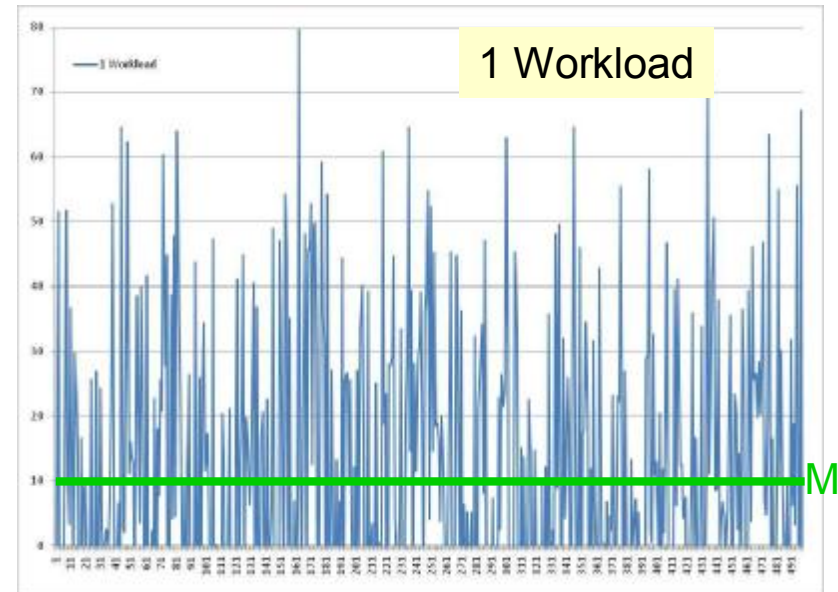
# The effect of memory constraints

## Response time



## Variability In Workload Demand

- § Variations in workload demand measured by time interval
- § The mean **M** is the average utilization over all the time intervals
- § **Sigma** (the Standard Deviation) is a measure of how widely the intervals differ from the mean (greater sigma means more variation in workload demand)
  - 2 standard deviations from the mean: approximately 95% of all values are less than this



## What is a typical value of sigma?

IBM Survey Of Workload Variability In 3200 Servers:

<b>Type Of Workload</b>	<b>Average Utilization</b>	<b>Peak Utilization</b>	<b>Sigma</b>
Infrastructure	6%	35%	2.5 * Mean
Web Server	4%	24%	2.5 * Mean
Application	4%	34%	3.75 * Mean
Database	5%	37%	3.25 * Mean
Terminal	6%	45%	3.25 * Mean
E-Mail	4%	34%	3.75 * Mean

**We picked a sigma of 2.5\*Mean**

IBM System x™ Servers and VMware Virtual  
Machine Sizing Guide  
Legacy workloads on XEON 2.5-2.8GHz Servers

\* Normal probability distribution

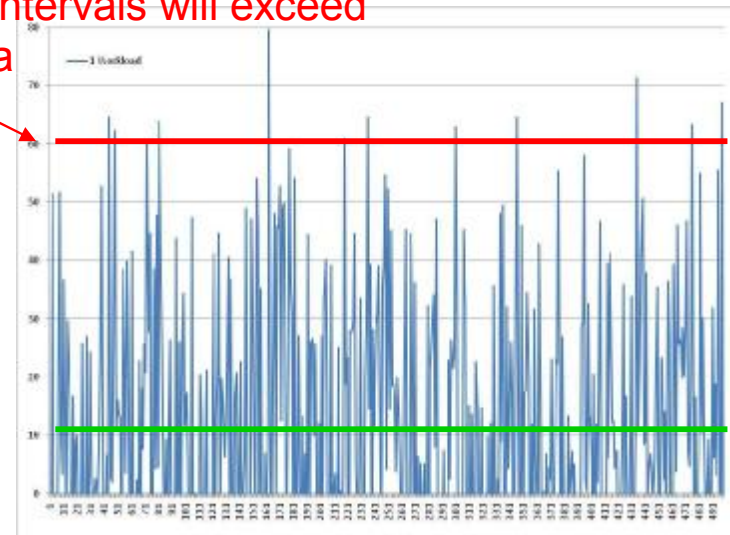
# Service Level Agreements

§ Service Level Agreement stipulates that only a small fraction of intervals may exceed the capacity of the machine

§ For example\*

- Only 5% of intervals will exceed  $M + 2 * \text{Sigma}$

Only 5% of intervals will exceed  $M + 2 * \text{Sigma}$



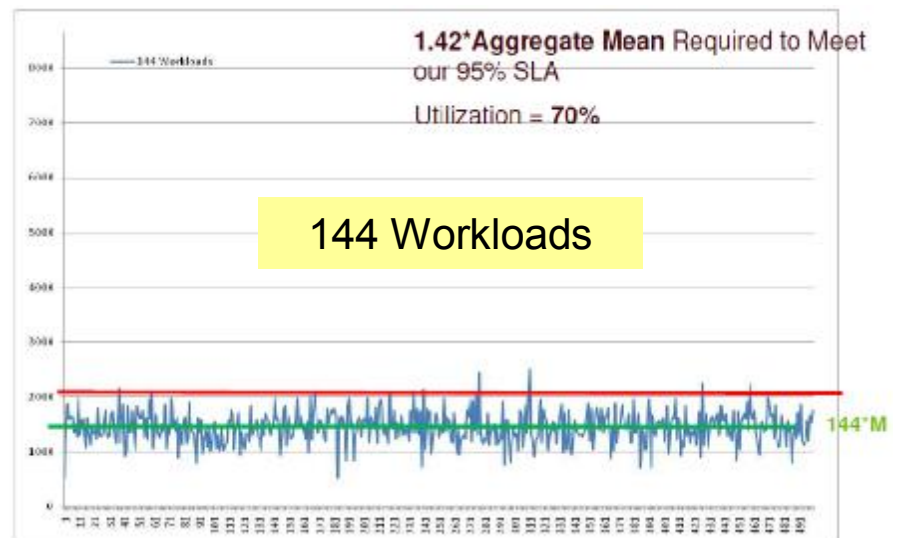
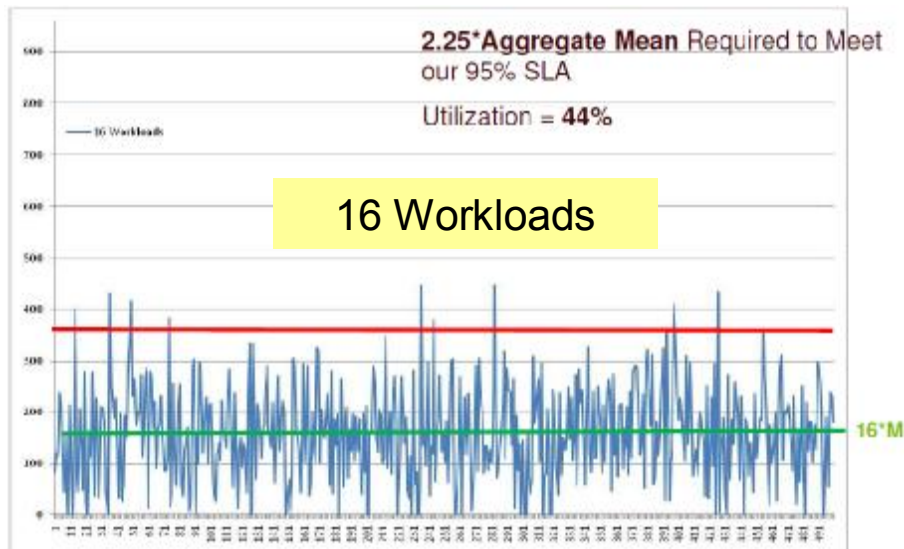
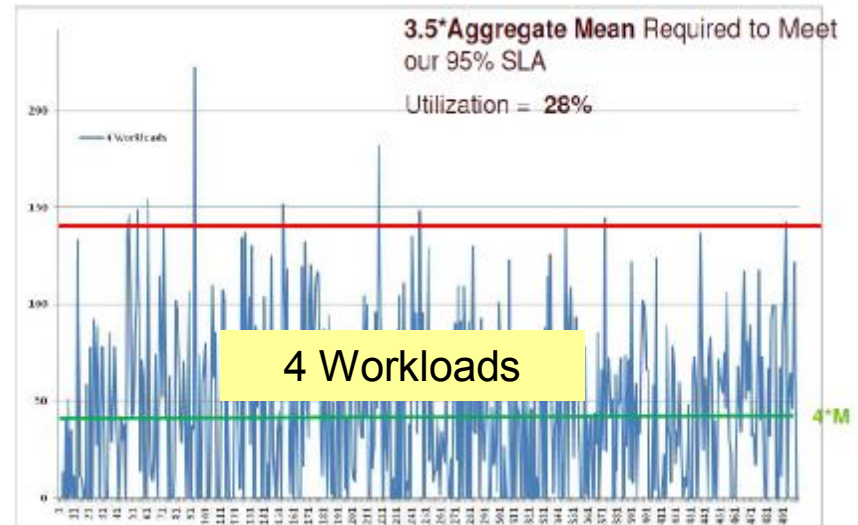
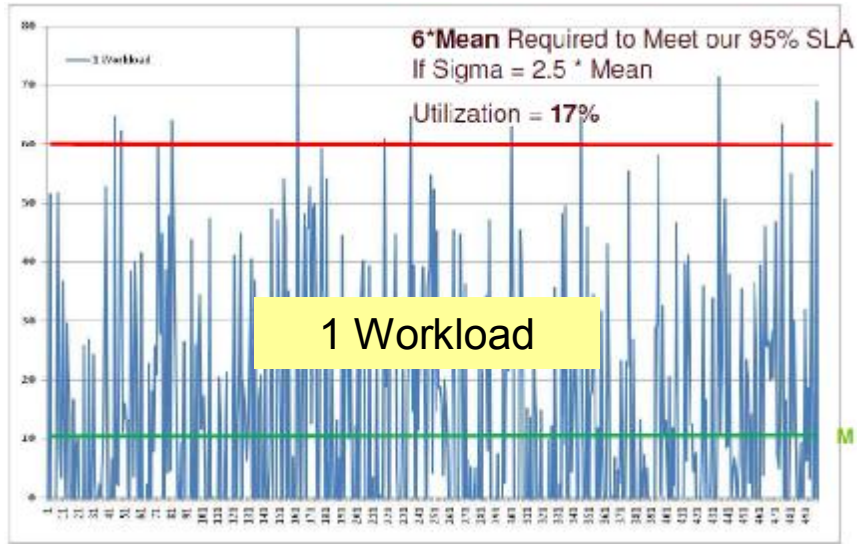
M

When  $\text{Sigma} = 2.5 * \text{Mean}$ , a machine capacity of  $6 * M$  is required

The average utilization will be 17%!

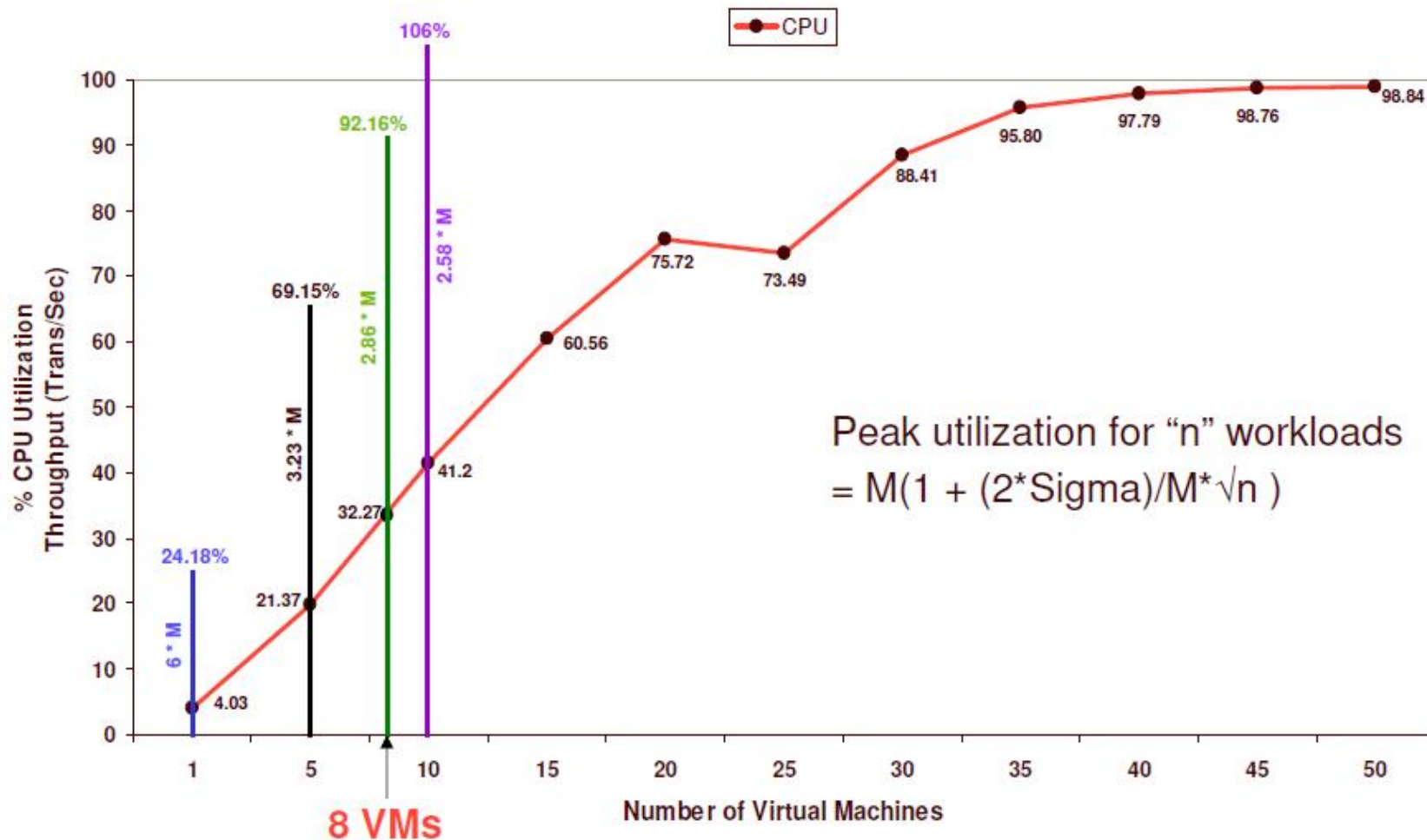
\* Normal probability distribution

# When we consolidate...

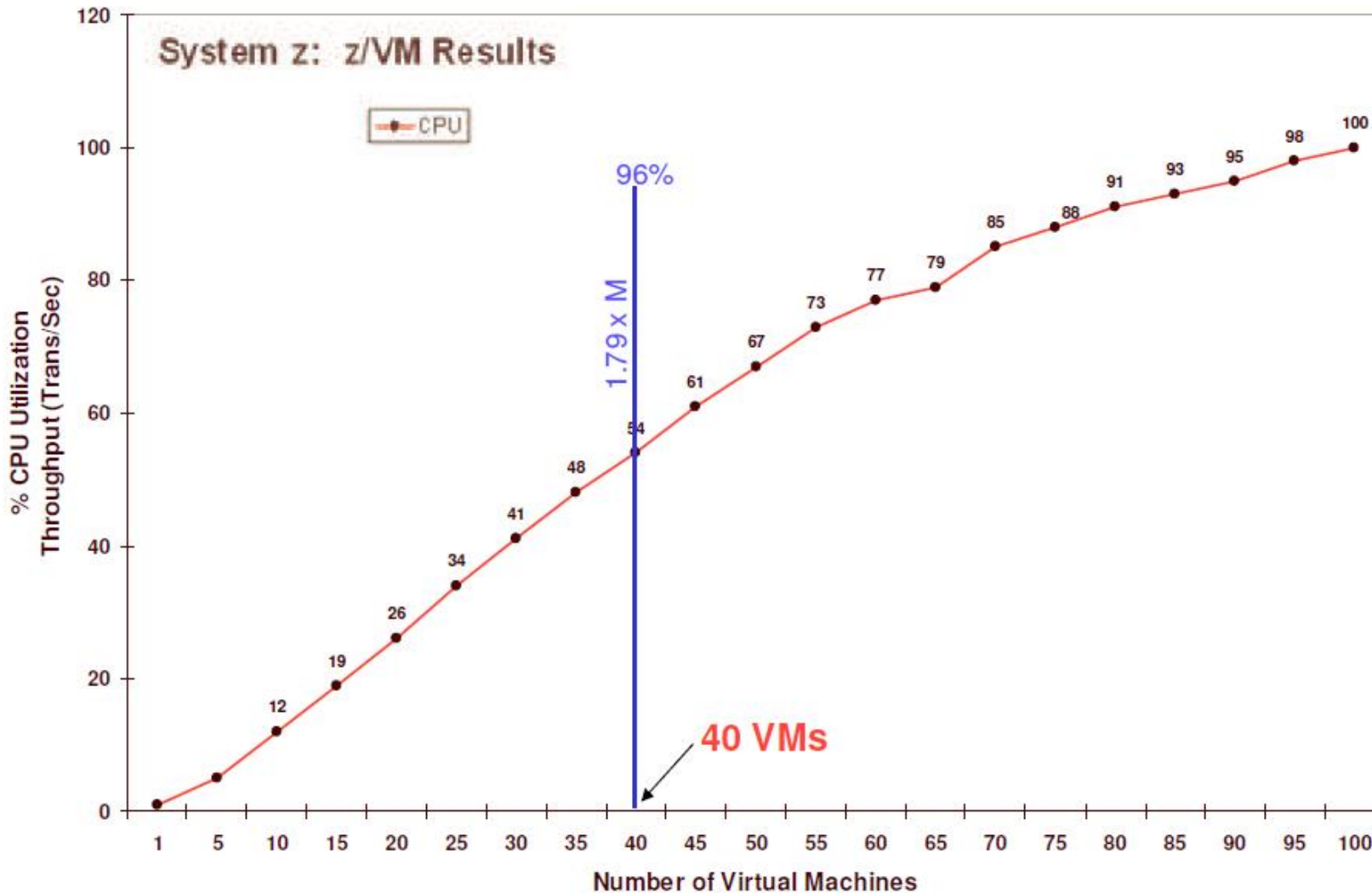


# Apply utilization SLA to derive consolidation ratio for x86 Hypervisor

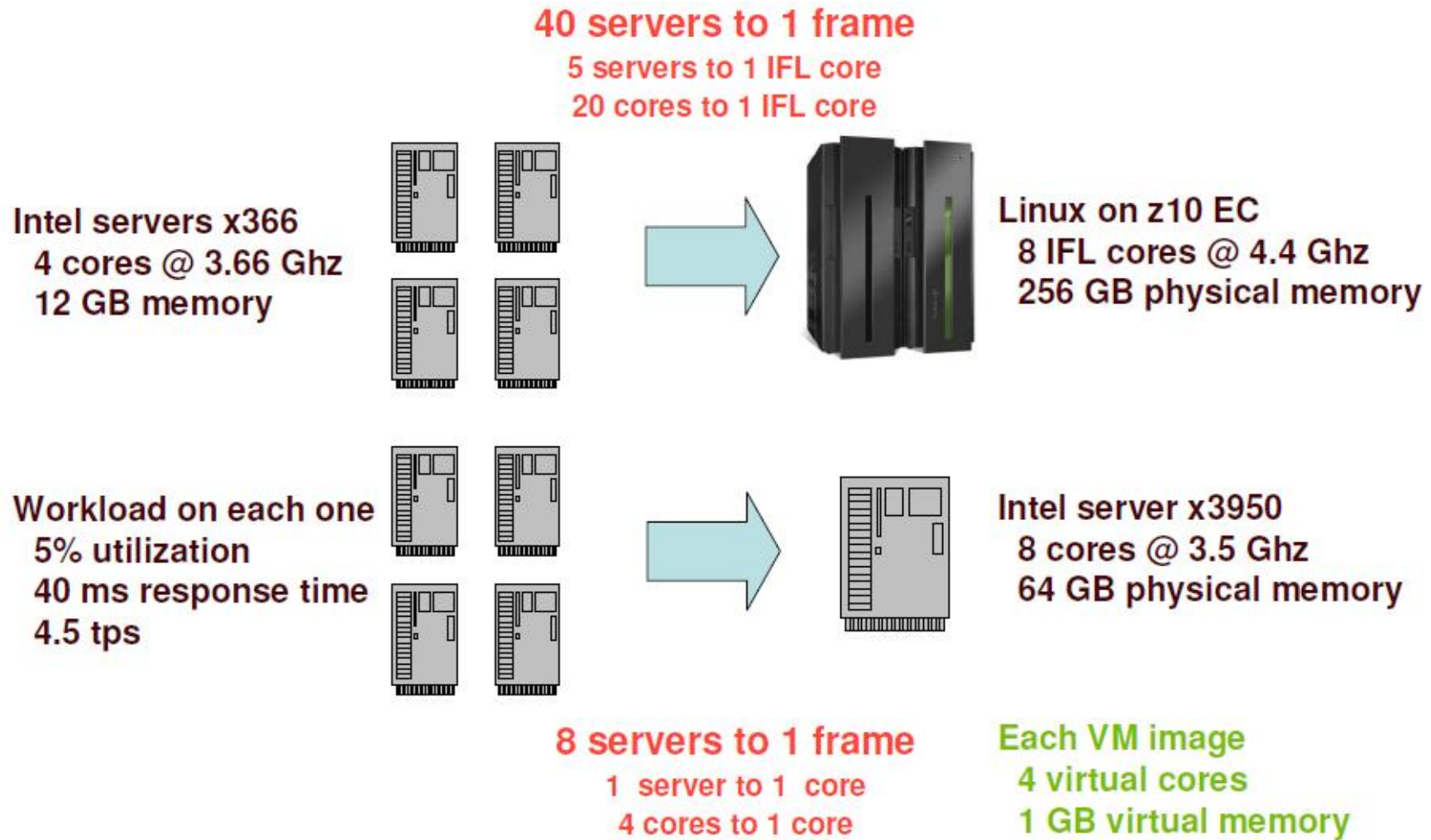
x86 Hypervisor results



# Apply utilization SLA to derive consolidation ratio for z/VM

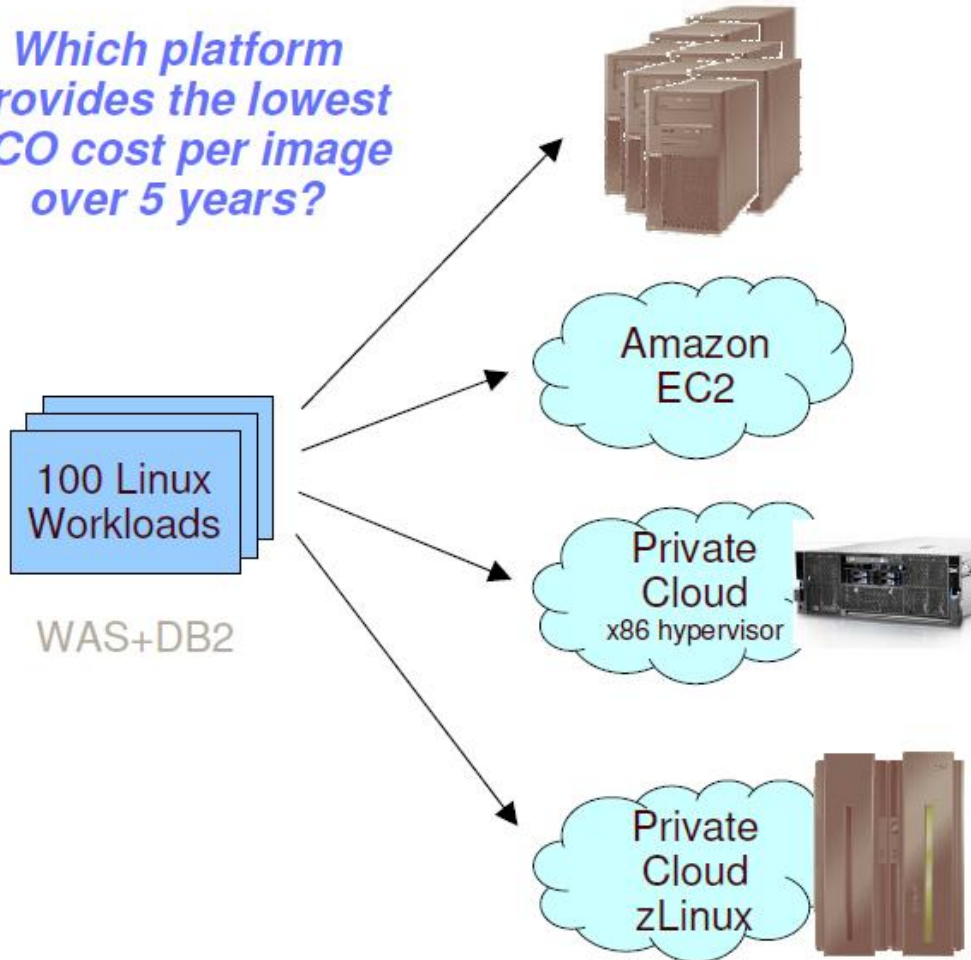


# Consolidation ratios needed to satisfy Service Level Agreement



# Use benchmark ratios to compare TCO

*Which platform provides the lowest TCO cost per image over 5 years?*



## Requirements

Buy 100 IBM x3250 4-core servers

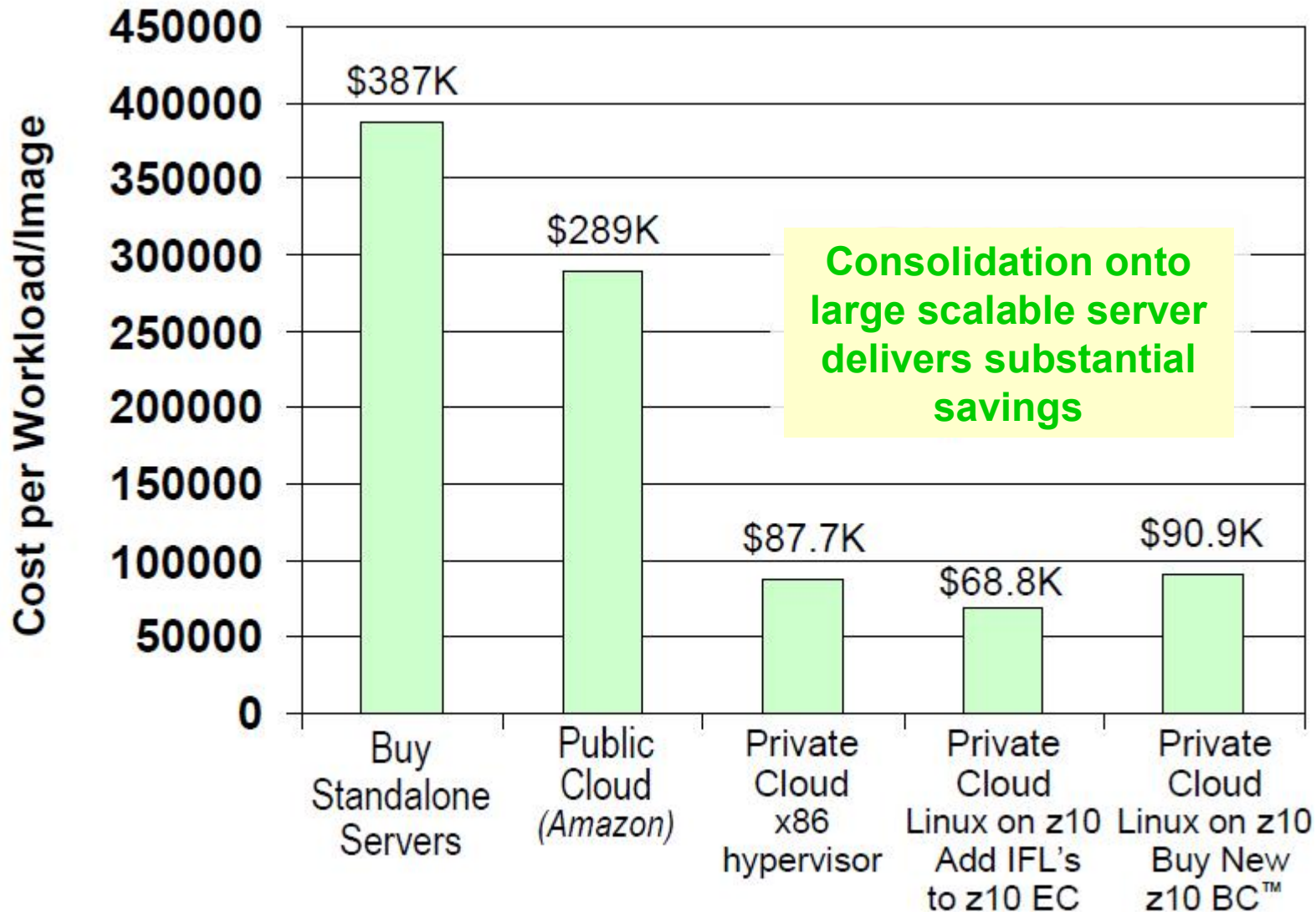
100 Amazon EC2 Instances

8 IBM x3950 8-core servers  
 $100 / (1.7 \times 8) = 7.3 \rightarrow 8$

12 IFLs on existing IBM z10 EC  
 $100 / (1.7 \times 5) = 11.8 \rightarrow 12$

100 WAS on Linux workloads (1.7 oversold)

## Cost per image for Linux workloads (5 yr TCO)



## Detailed Cost Breakdown for Linux Workloads (5 Yr TCO)

	Buy Another Server	Rent a Virtual Server	Provision Your Own (x86 hypervisor)	Provision Your Own (Linux on System z10)
Runtime Platform	100 IBM x3250 with 4 cores each	100 Amazon Extra Large EC2 instances	8 IBM x3950 with 8 cores each	12 IFLs added to existing IBM z10 EC
Hardware Costs <ul style="list-style-type: none"> <li>■ Server</li> <li>■ Storage</li> <li>■ Networking</li> </ul>	\$5,000,000	\$2,880,000	\$1,390,000	\$3,000,000
Software Costs <ul style="list-style-type: none"> <li>■ OS (Linux)</li> <li>■ Hypervisor (on x86, z/Linux)</li> <li>■ App Server (IBM WAS)</li> <li>■ Database (IBM DB2)</li> <li>■ Monitoring (ITCAM for Apps)</li> </ul>	\$22,660,000	\$22,010,000	\$3,987,000	\$2,644,000
Facilities and Admin <ul style="list-style-type: none"> <li>■ Power</li> <li>■ Floor space</li> <li>■ Maintenance</li> <li>■ Systems admin</li> </ul>	\$11,020,000	\$4,020,000 <i>(admin only)</i>	\$3,395,000	\$1,240,000
<b>Total Cost</b>	<b>\$38,680,000</b>	<b>\$28,910,000</b>	<b>\$8,772,000</b>	<b>\$6,884,000</b>
Number of Workloads/Images Supported	100	100	100	100
<b>Total Cost per Image</b>	<b>\$386,800</b>	<b>\$289,100</b>	<b>\$87,720</b>	<b>\$68,840</b>

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## *Benefits of virtualization*



### ***Simplified infrastructure and management***

- § Logical consolidation independent of physical infrastructure
- § Physical consolidation keeping workload separation
- § Simplification and standardization of management
- § Increased administrator productivity
- § Increased resource utilization



### ***Improved application availability***

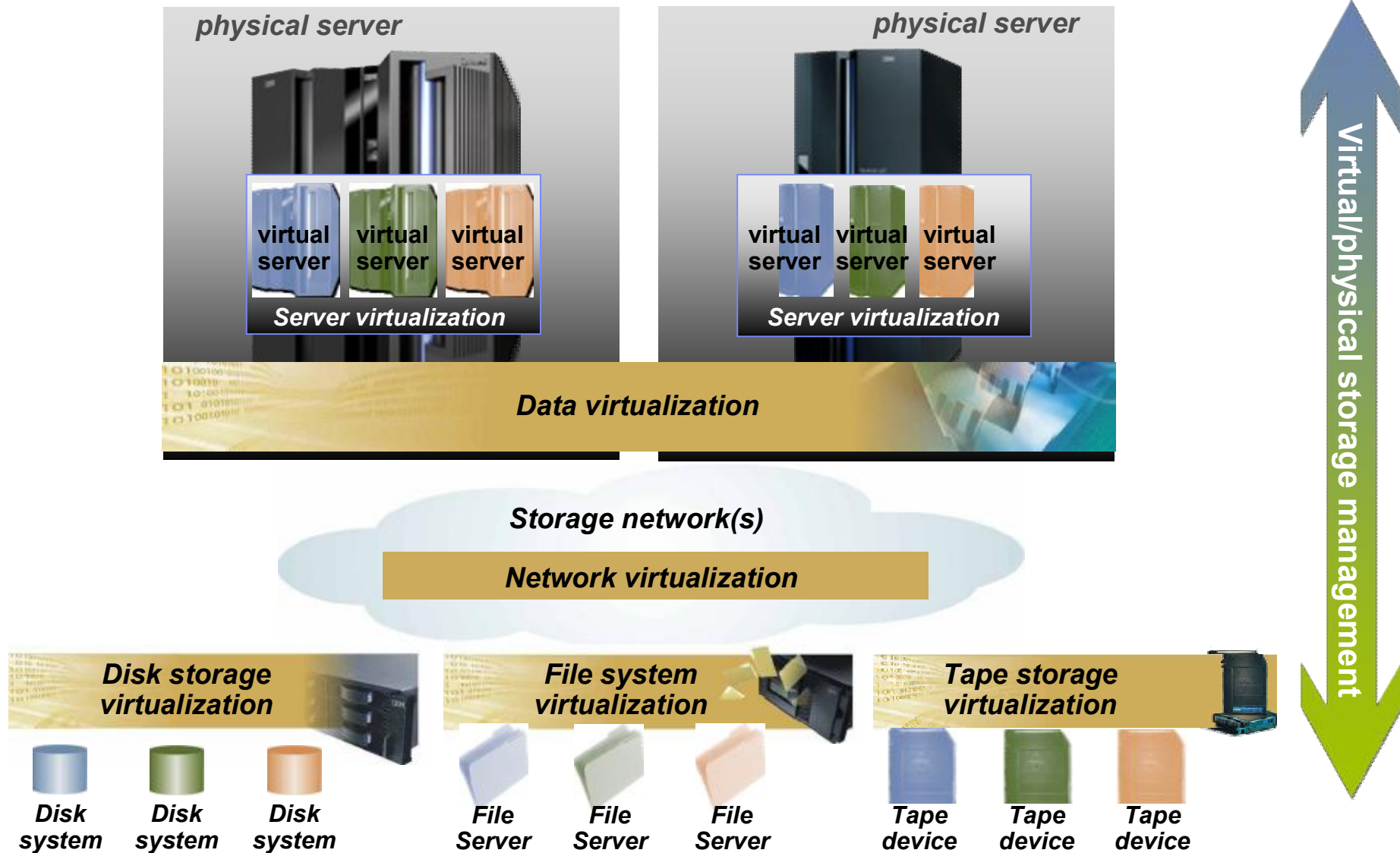
- § Moving data non-disruptive to applications
- § Simplified use of storage classes



### ***Removal of physical infrastructure limitations***

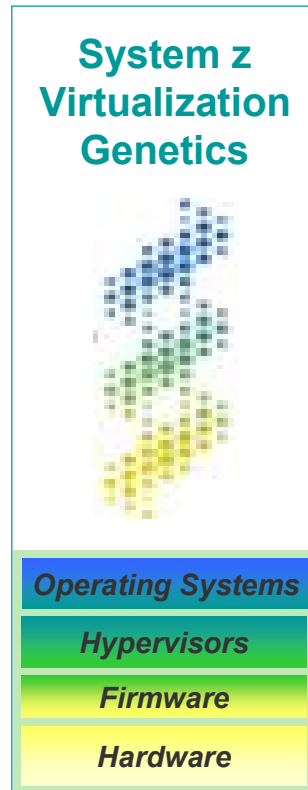
- § Allows for information management independent of storage location
- § Increased flexibility and shorter time to react
- § Choice of multi-vendor equipment

# Virtualized infrastructure



## Matching the attributes of a Dynamic Infrastructure: *Extreme Virtualization capabilities on System z*

- § **Sharing everything** architecture
- § **High granular** resource sharing (less than 1% utilization)
- § **Application integration** with HiperSockets™ and VLANs
- § **Resource overcommitment** handled extremely well
- § **Simulated devices** that aren't physically present
- § **Virtual disks** in storage
- § Resources **consumption recording/reporting**
- § Intelligent and autonomic **workload management**
- § New virtual server **deployment in minutes**
- § Designed to run **multiple and mixed workload** concurrently
- § Hardware-enforced **isolation**
- § **Autonomic, non-disruptive** disk failover
- § **Hot stand-by** without the hardware expense
- § **Non-disruptive On/Off Capacity on Demand** capability
- § High levels of **reliability, availability and security** built into hardware



## IBM consolidation highlights

### § IBM Consolidation Effort

- 3900 servers to 15 - z10 mainframes
- 80% savings in annual energy usage
- 85% savings in total floor space
- Improved availability and DR

### § Initial investment into methodology

- "Consolidation factory"
- IBM Services know-how



### **IBM'S PROJECT BIG GREEN SPURS GLOBAL SHIFT TO LINUX ON MAINFRAME**



Plan to shrink 3,900 computer servers to about 30 mainframes targets 80 percent energy reduction over five years

*Optimized environment to increase business flexibility*

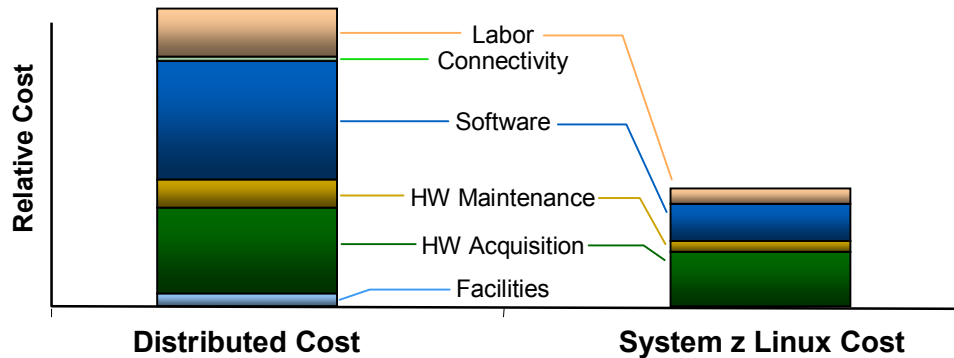
**ARMONK, NY, August 1, 2007** – In one of the most significant transformations of its worldwide data centers in a generation, IBM (NYSE: IBM) today announced that it will consolidate about 3,900 computer servers onto about 30 System z mainframes running the Linux operating system. The company anticipates that the new server environment will consume approximately 80 percent less energy than the current set up and expects significant savings over five years in energy, software and system support costs.

At the same time, the transformation will make IBM's IT infrastructure more flexible to evolving business needs. The initiative is part of Project Big Green, a broad commitment that IBM announced in May to sharply reduce data center energy consumption for IBM and its clients.

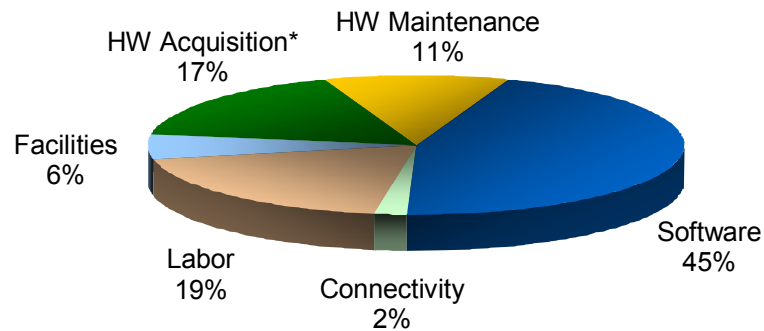
# Client view of TCO comparison

Similar distributed workload vs. System z Linux results in potential 60-75% Gross Costs Savings

## Operating Cost: Distributed vs. Mainframe



## Potential Savings: Categories as a % of Gross Savings



\* HW Acquisition compares server/disk refresh of distributed environment to the cost of acquiring new mainframes/storage

## Dramatic Simplification

Unit	Distributed	System z Linux	% Reduction
Software Licenses	26,700	1,800	93%
Ports	31,300	960	97%
Cables	19,500	700	96%
Physical Network Connections	15,700	7,000	55%

Results will vary based on several factors including # of servers and work load types

## Virtualization is key to achieving these results... and System z leads the way



- § Dramatically reduce **operating costs** by up to 70%
- § Spend up to 85% less on environmental expenses such as **floor space and energy**
- § **IT resources** provisioned to match business and user demand
- § Rapid Prototyping enables faster **speed to market** for improved business results
- § **Optimize IT Staff productivity** for deploying and managing many virtual servers
- § Handle unpredictable **workload volumes**
- § Enable **innovation** through virtual resources to develop new solutions
- § **Delivering business continuity** for secure global operations

# Dynamic Infrastructure and Cloud Computing



...leverages virtualization, standardization and automation to free up operational budget for new investment



... allowing you to optimize new investments for direct business benefits



**Linux<sup>®</sup> on IBM System z<sup>®</sup>**  
matches the attributes  
and provides unique values





# Questions and Answers

**For more information, please  
contact me at:  
[Siegfried.Langer@de.ibm.com](mailto:Siegfried.Langer@de.ibm.com)**

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DB2 Connect	HyperSwap	System z10	zSeries*
Dynamic Infrastructure*	Informix*	System z10 Business Class	z9
Enterprise Storage Server*	MQSeries*	Tivoli	z10
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FICON*	Parallel Sysplex*	VSE/ESA	z10 EC

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