A Fresh Look at the Mainframe
When the Mainframe Really IS the
Lowest Cost Platform

Ray Jones
WW Vice President, z Software

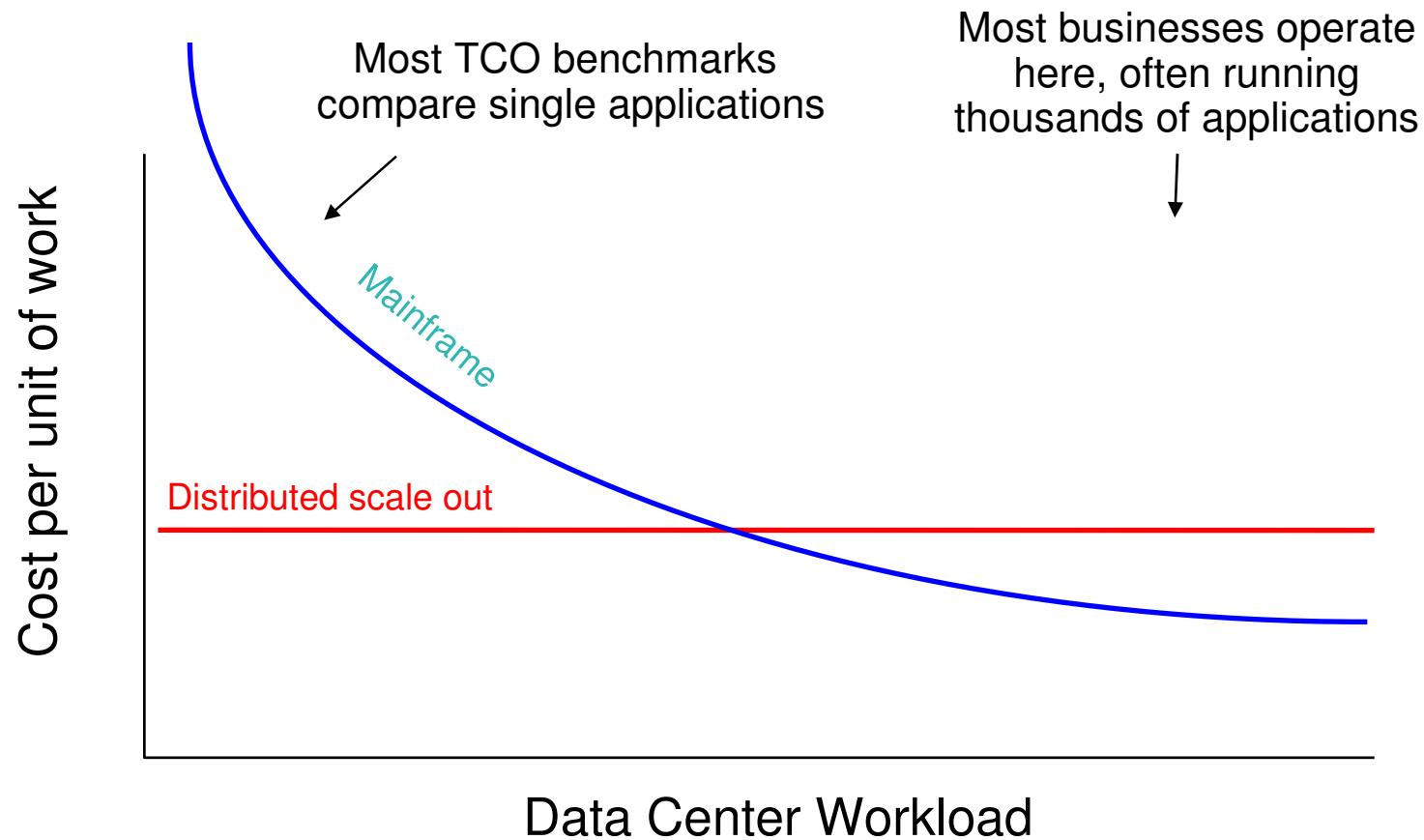# Let's Break Down the Elements of Cost

Total Cost of Ownership =

Hardware/Maintenance

+ IBM Software

+ Environmentals

+ Labor

+ required Quality-of-Service

(Availability, Security, Disaster/Recovery…)

+ other Elements

(Chargeback)

The total cost requires a total picture of your I/T assets and expenses

Mainframe Cost/Unit of Work Decreases as Workload Increases

Most TCO benchmarks compare single applications

Most businesses operate here, often running thousands of applications

Cost per unit of work

Mainframe

Distributed scale out

Data Center Workload

Utilization of Distributed Servers & Storage

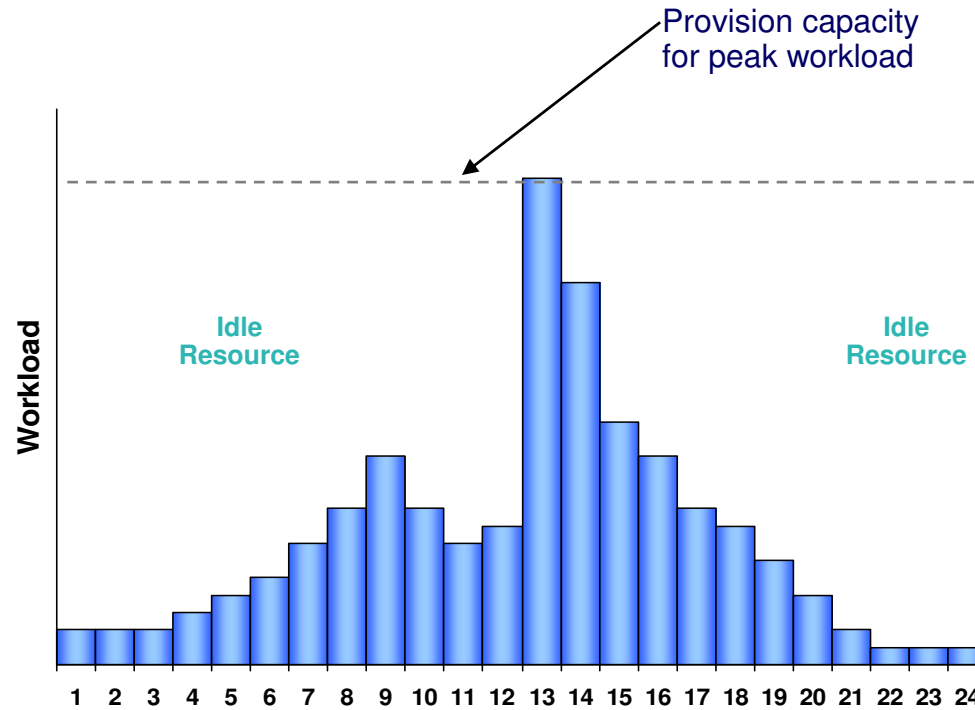Typical utilization of:

Windows Servers 5-10%

UNIX Servers 10-20%

System z Servers 85-100%

Server dedicated to one application

The cost of storage is typically three times more in distributed environments

Provision capacity for peak workload

Workload

Idle Resource

Idle Resource

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

- **Storage Allocation**
  - ▶ Application-specific resulting in over-allocations
  - ▶ Fine grained storage allocation mechanisms characteristic of mainframe storage are uncommon in distributed environments.

- **Storage Utilization**
  - ▶ Single digit utilization for distributed environments is not uncommon
  - ▶ Storage utilization of 80% + is typical for mainframe

- **Storage Management**
  - ▶ Data disaster recovery, synchronization, and transfer requirements add complexity and cost

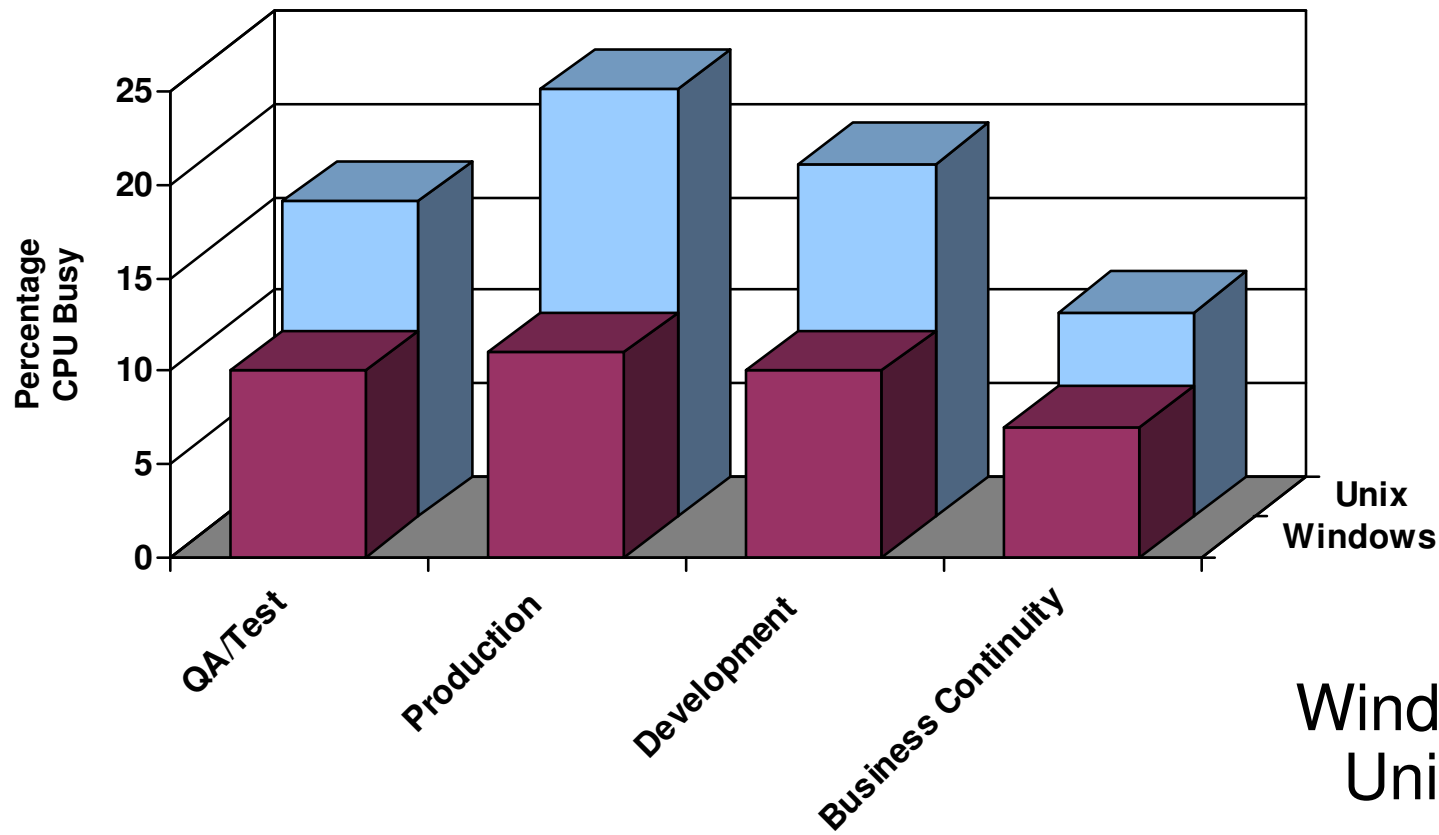*Application specific storage allocations tend to occur in large units…*

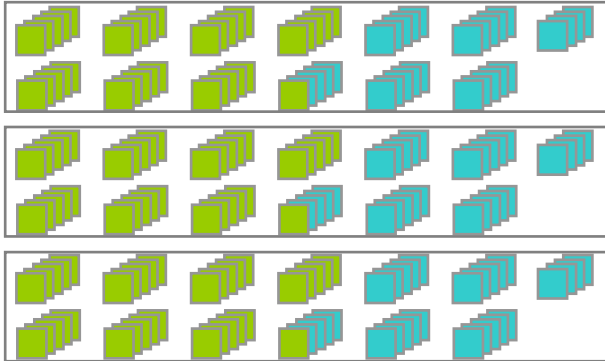*resulting typically in single digit utilization*

Server Utilization at a Large Financial Institution

Average Server Utilization by Class
Feb-06

Windows 5-10%
Unix 10-20%

This Was a Real Project – Why Couldn't The Same Workload Be Done With Faster Processors?

3x HP 64-way Production Application and DB

1x HP 64-way Dev&Test / Batch
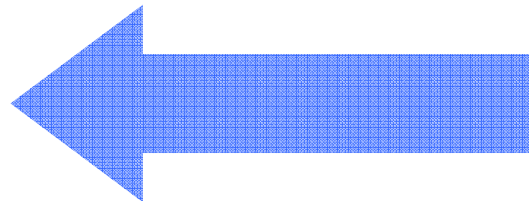
2x HP 32-way PL/1 (Mgmt, Dev&Test, and Batch)

Plus:
2x HP 16-way servers : external, HP rx8620
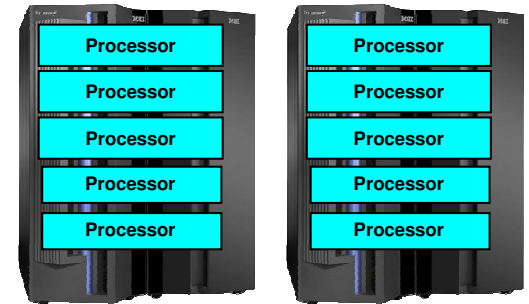3x IBM P570 servers : Web Appl server

17 processors
(6,700 MIPS)

320 Unix
processors
(816,002 RPE's)

2x z990 5-way (production)

Processor
Processor
Processor
Processor
Processor

Processor
Processor
Processor
Processor
Processor

z990 7-way (production + test)

Processor
Processor
Processor
Processor
Processor
Processor
Processor

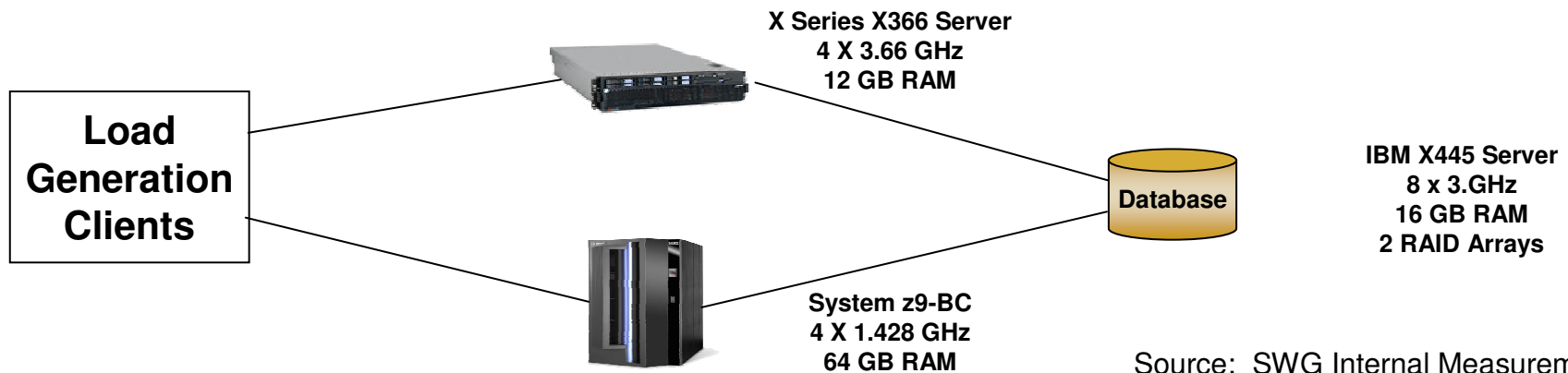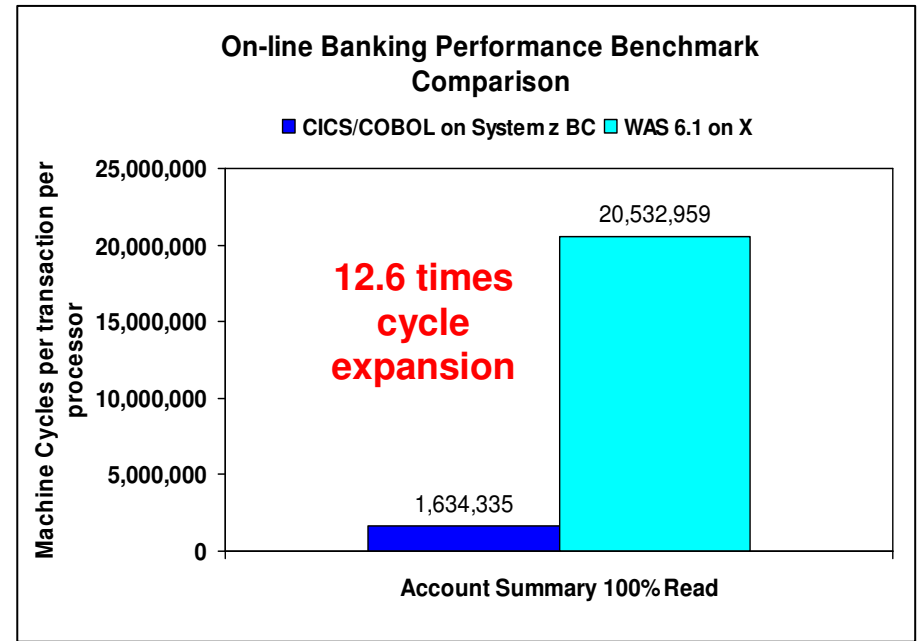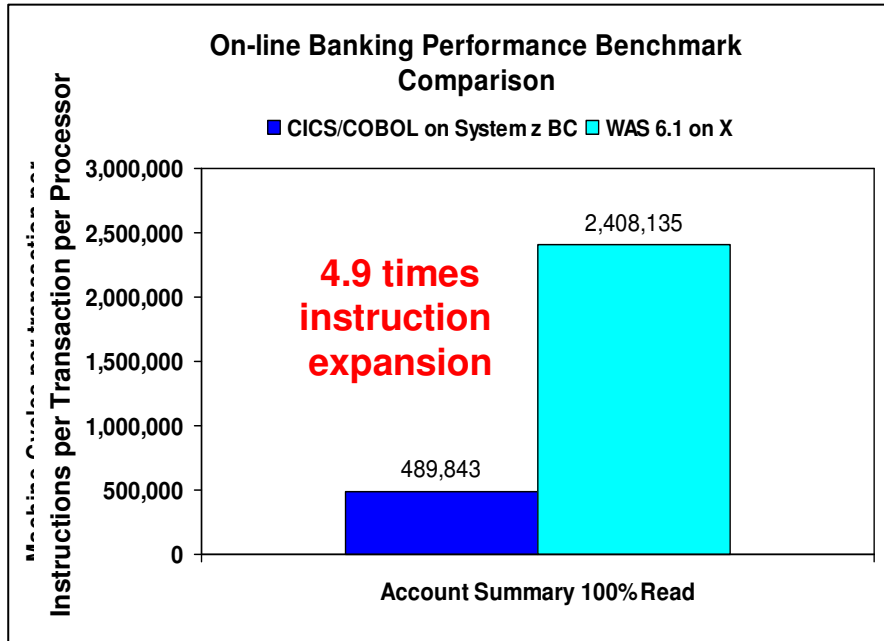## 122 RPE's per MIP

Some disaster recovery

Benchmark - Code Expansion When Moving From CICS/Cobol To Java On Wintel (Higher Is Worse)

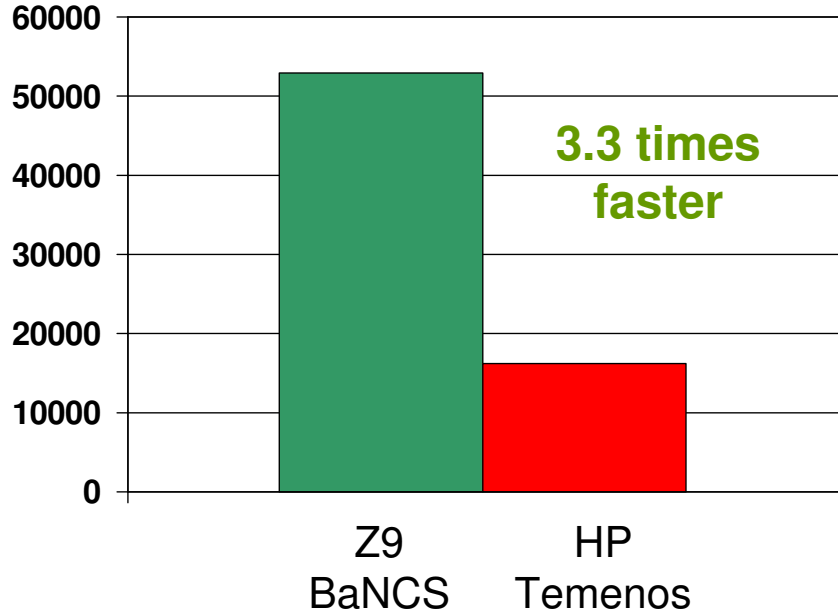## On-line Banking Performance Benchmark Comparison

■ CICS/COBOL on System z BC ■ WAS 6.1 on X

Machine Cycles per operation per Instructions per Transaction per Processor

3,000,000	
2,500,000	2,408,135
2,000,000	
1,500,000	
1,000,000	
500,000	489,843
0	

4.9 times instruction expansion

Account Summary 100% Read

On-line Banking Performance Benchmark Comparison

■ CICS/COBOL on System z BC ■ WAS 6.1 on X

Machine Cycles per transaction per processor

25,000,000	
20,000,000	20,532,959
15,000,000	
10,000,000	
5,000,000	
0	1,634,335

12.6 times cycle expansion

Account Summary 100% Read

X Series X366 Server
4 X 3.66 GHz
12 GB RAM

Load Generation Clients

Database

IBM X445 Server
8 x 3.GHz
16 GB RAM
2 RAID Arrays

System z9-BC
4 X 1.428 GHz
64 GB RAM

Source: SWG Internal Measurements

System z Batch Processing Performance

End of Day Batch Processing Accounts Per Second

- **Bank of China** BMT*
  - ▸ **IBM System z9**
  - ▸ **TCS BaNCS (Cobol)**
  - ▸ **380** Million Accounts
  - ▸ End of Day processing – 175M accounts finished in 55 minutes (52,970 accounts/second)

- **HP/Temenos** BMT**
  - ▸ **HP Itanium**
  - ▸ **Temenos T24 (Java)**
  - ▸ **13** Million Accounts
  - ▸ End of Day processing finished in 13.33 minutes (16,250 accounts/second)

3.3 times faster

Chart:
- Y-axis: 0, 10000, 20000, 30000, 40000, 50000, 60000
- Z9 BaNCS: ~53000
- HP Temenos: ~16250

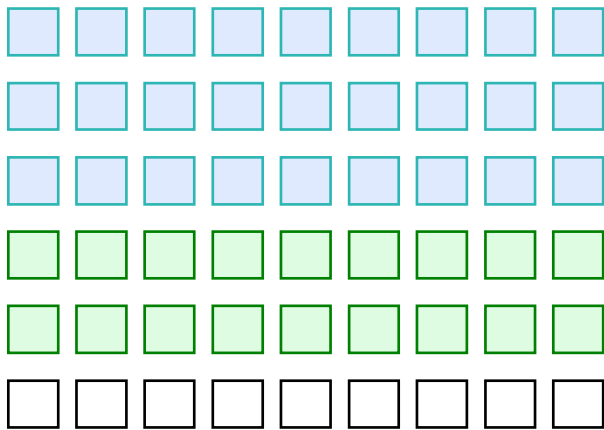**SOURCE:***http://www.enterprisenetworksandservers.com/monthly/art.php?2976 **Source**: InfoSizing FNS BANCS Scalability on IBM System z – Report Date: September 20, 2006
SOURCE:**TEMENOS BENCHMARKS; http://h71028.www7.hp.com/enterprise/downloads/TemenosBenchmark.pdf

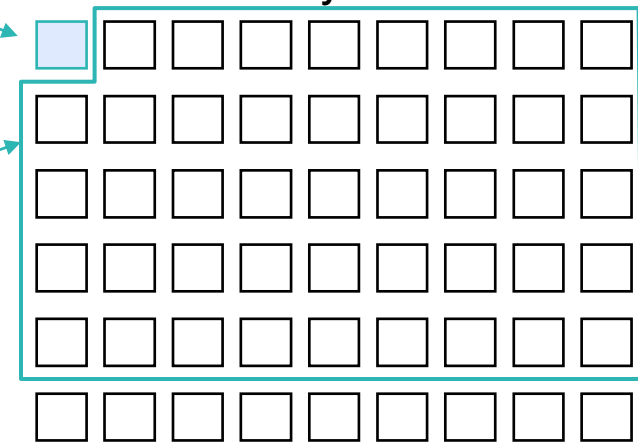# Disaster Recovery – Fast Failover For Less

Primary Site

64 way SMP

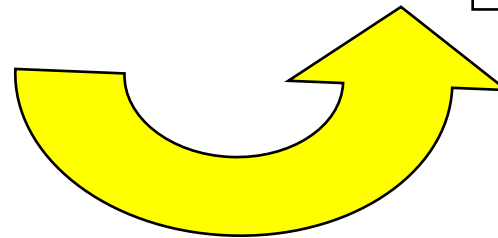*Pay regular price for one active processor to enable fast failover*

Pay much less for each dormant processor to maintain capacity back up on demand

Alternative Site

64 way SMP

Pay regular price for frame

Site Failover With GDPS

Note: other scenarios can reduce the price further

TCO Case Studies – Core Proliferation Defeats Offload Savings

Scenarios	Cost of Distributed vs. z			Distributed Cost Ratio	Cores vs. z Processors			Core Ratio	Performance Units per MIP
Offloading cases									
– Banking Benchmark	$43.3M	vs	$18.2M	2.4x	560	vs	7	80 : 1	187:1
– NA financial company	$84.7M	vs	$24.2M	3.5x	264	vs	6	44 : 1	482:1
– European financial	$17.9M	vs	$4.9M	3.7x	52	vs	2	26 : 1	670:1
– Asian financial company	$119 M	vs	$53 M	2.2x	408	vs	17	24 : 1	122:1
Offloading studies									
– European agency	€386M	vs	€204 M	1.9x	568	vs	30	19 : 1	185:1
– Restaurant chain	$56.3M	vs	$23.3M	2.4x	32	vs	4	8 : 1	116:1
Offloading studies pending									
– US Utility	$13.4M	vs	$6.2M	2.2x	112	vs	3	37 : 1	
– US Manufacturer	$64.0M	vs	$43.3M	1.5x	96	vs	6	16 : 1	
				2.5x				**32 : 1**	**294:1**

Trade-In Value Reduces Mainframe Net Present Value Costs

- Upgrade to next generation mainframe
  - ▶ Specialty processors are upgraded to next generation free of charge
  - ▶ Growing customers typically receive credit for existing MIPS investment when upgrading to new generation
  - ▶ Full trade-in value applied to upgrade and growth MIPS

- Upgrade to next generation distributed systems
  - ▶ Life time of 3 to 5 years
  - ▶ Must repurchase existing processor capacity plus any growth

- Long term TCO implications can be important

Case Study: Government Runs Oracle At IFL Prices

- Running 292 server instances on one z9-EC with 5 IFLs
  - 200 Oracle, 80 WebSphere, 12 WebSphere messaging
  - Reduced cost of hardware and software by 30%
    - Saved $800,000 in licensing cost in the first year
  - Used RACF for consistent security
  - Each administrator can manage 100 consolidated Linux images
  - Fast provisioning
    - Create new Linux server in 30 min   (vs. 1 week – 3 months)
    - Clone Oracle DB instance in 30-45 min   (vs. 10 – 14 hours)
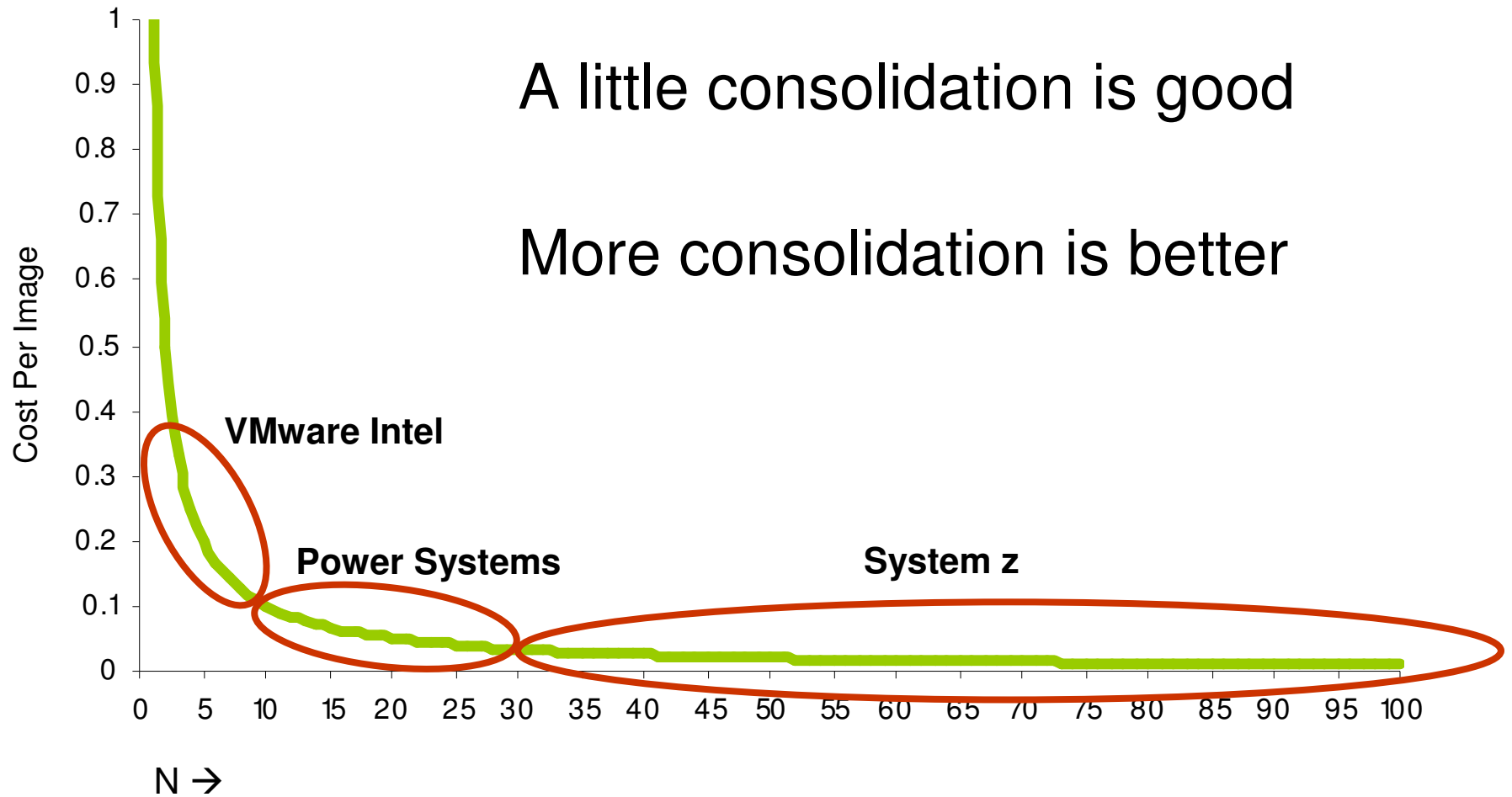 - Inherited benefits of z platform – workload management, availability, disaster recovery, I/O bandwidth

Other Benefits Of Virtualization

- Fast provisioning of pre-installed and configured images

  ▶ Minutes instead of days or weeks

  ▶ No additional space, electric connections or network cables

- Compatible with the data center practice of standardizing on strategic software stacks

  ▶ Pre-tested stacks

  ▶ Consistent release levels and maintenance approach

  ▶ A management approach to achieve better stability

  ▶ Jukebox selection of standard enterprise images

Observed Consolidation Ratios

A little consolidation is good

More consolidation is better

VMware Intel

Power Systems

System z

Cost Per Image

N →

Case Study: Network Costs –Before Consolidation (483 Servers to 2 System z's)

High Utilization Switch Module	14
Low Utilization Switch Module	12
Switch Interconnect Module	6
50 Ft UTP Cable	966
10GB Eth Fiber Cable	12
Switch Chassis	3

Backbone

Hardware Acquisition $748K
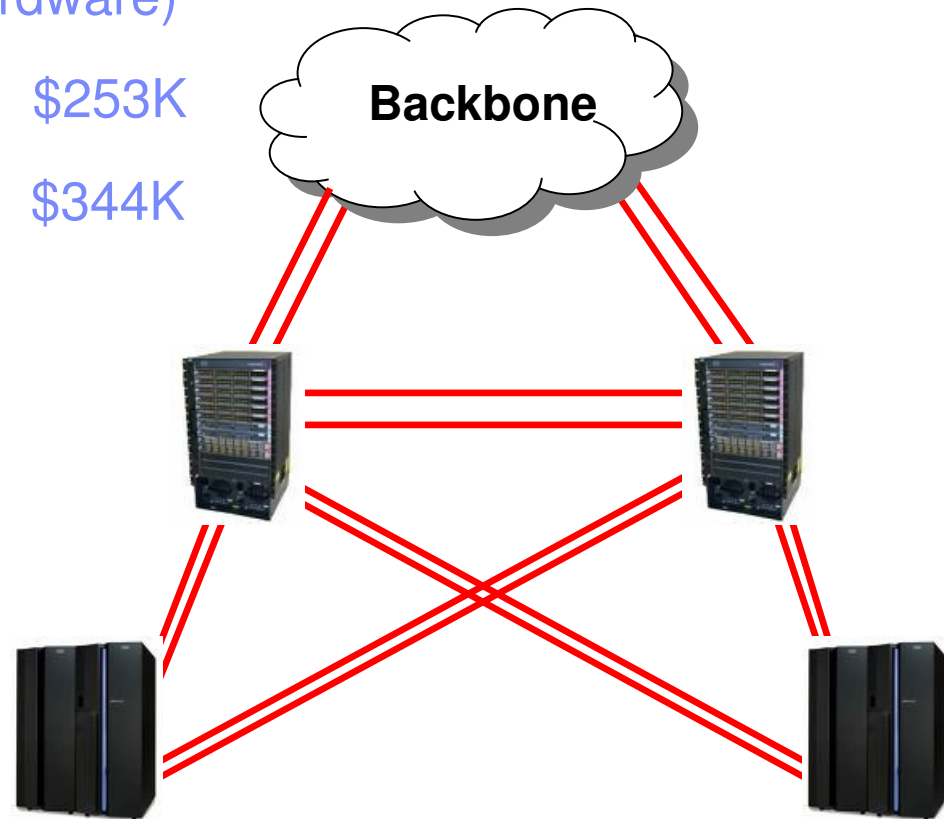Network Annual Costs $597K
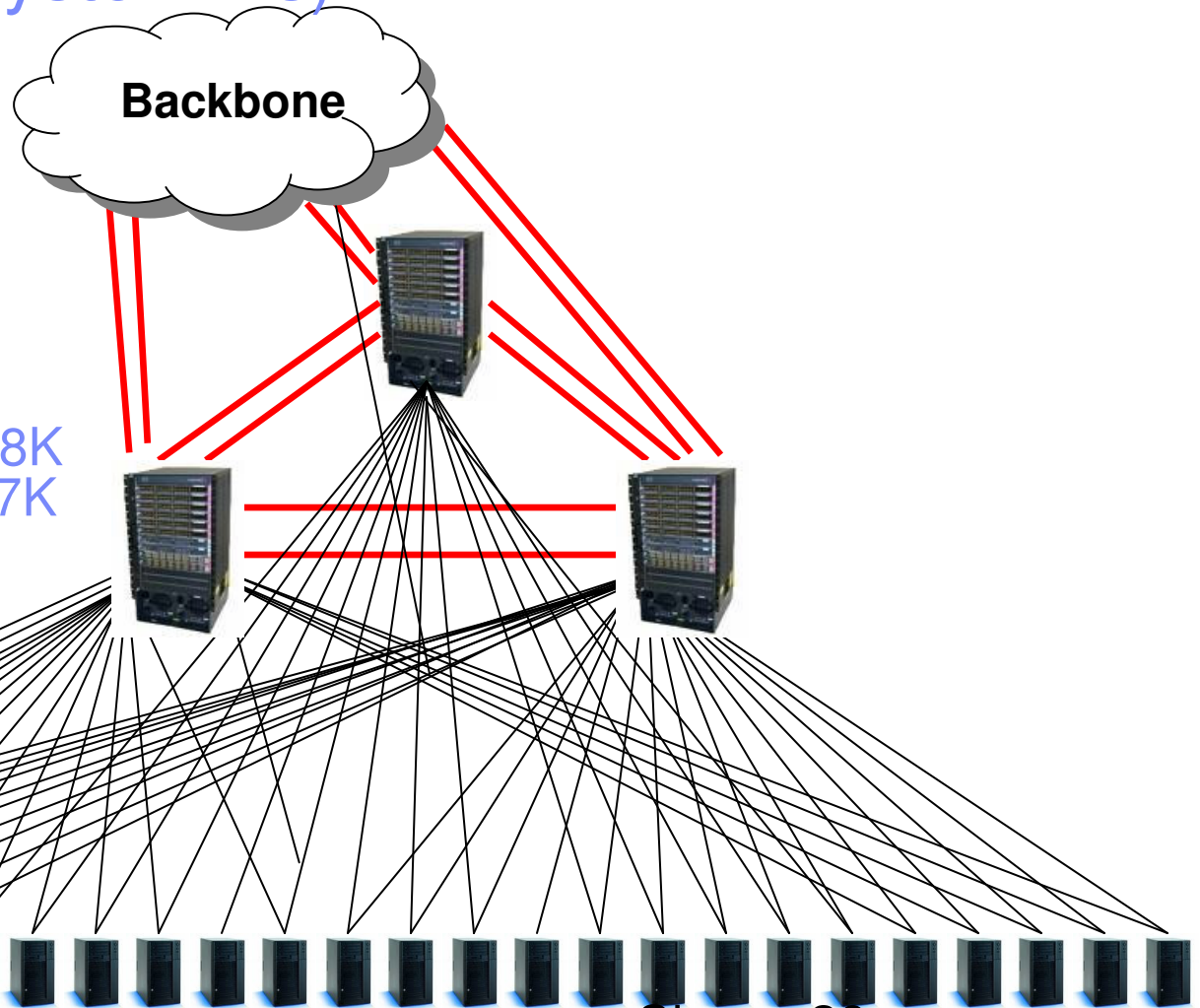
Shows **30**
of the **483** Servers

Case Study: Network Costs – After Consolidation (483 Servers to 2 System z's)

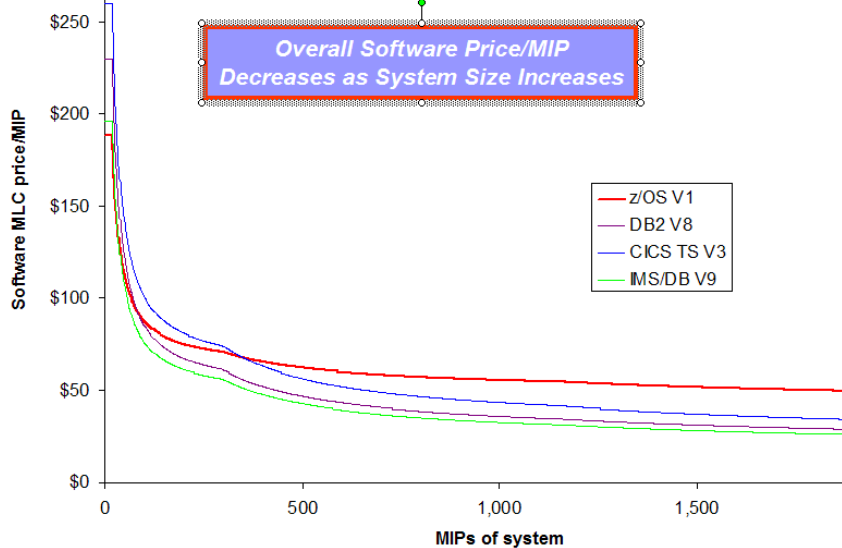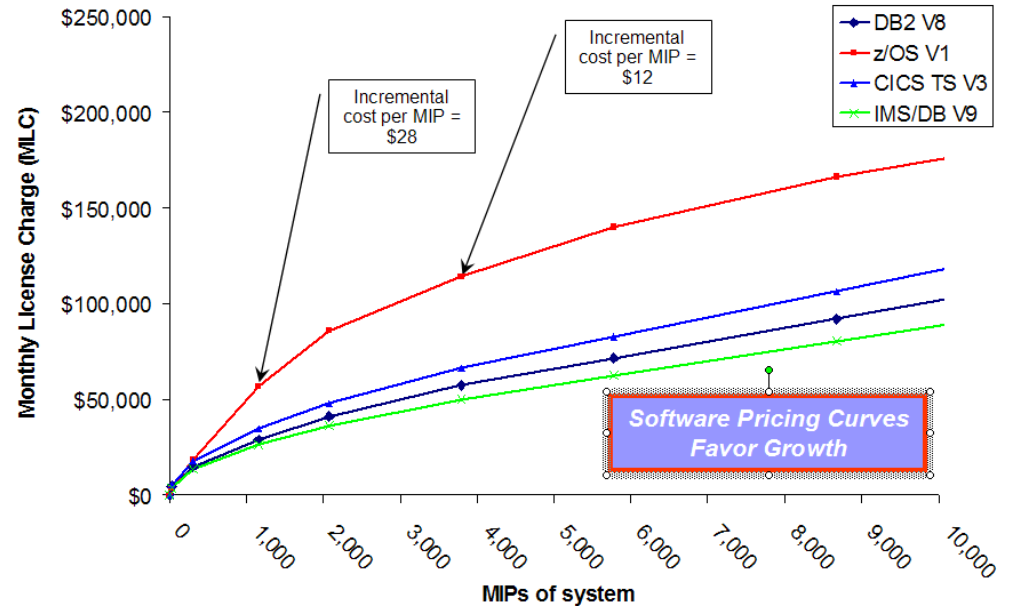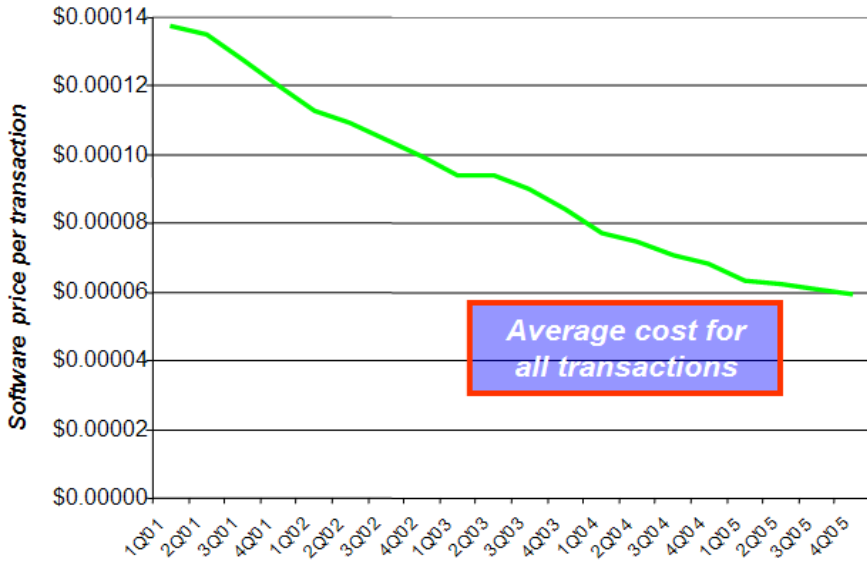New Hardware Acquisition $0
(reuse some of old network hardware)

"After" Network Annual Cost $253K

Network Annual Cost Savings $344K

Backbone

IBM Software Price Per Transaction is Going Down

Average cost for all transactions

Software Pricing Curves Favor Growth

Incremental cost per MIP = $28

Incremental cost per MIP = $12

Overall Software Price/MIP Decreases as System Size Increases

Putting This in Perspective

- For a typical system of 1,400 MIPS, MLC software stack costs $59 per incremental MIP

- If a transaction is 1 million instructions, an incremental MIP can perform >2½ million additional transactions per month for Δ$59 software cost (44K transactions per dollar)

- **If these are credit card transactions** of average $100 with a commission of 2%, the business makes $5.2M per month for a software cost of $59 per month (88,000 times return)

- **If this is a bank account** averaging 3 transactions a day, the business can do 40 years of account management for a software cost of $1

International Restaurant Chain Avoids High Cost Software

- Existing environment of 1600 MIPS included high cost ISV system management software

- Competitor's proposal was only a partial offload

  ▸ Complete offload projected to cost 2.3x more

  ▸ $56M vs $24M over 5 years

- System management software costs more in the offload case

  ▸ Mainframe systems management

    - $2.0M Stream per year (48 products, mostly third party)

  ▸ Distributed systems management

    - $2.6M Yearly Maintenance (26 products)

    - $13.3M One Time Charge

- Better: Replace higher cost System z ISV software with lower cost IBM Software

Portfolio Review and Analysis
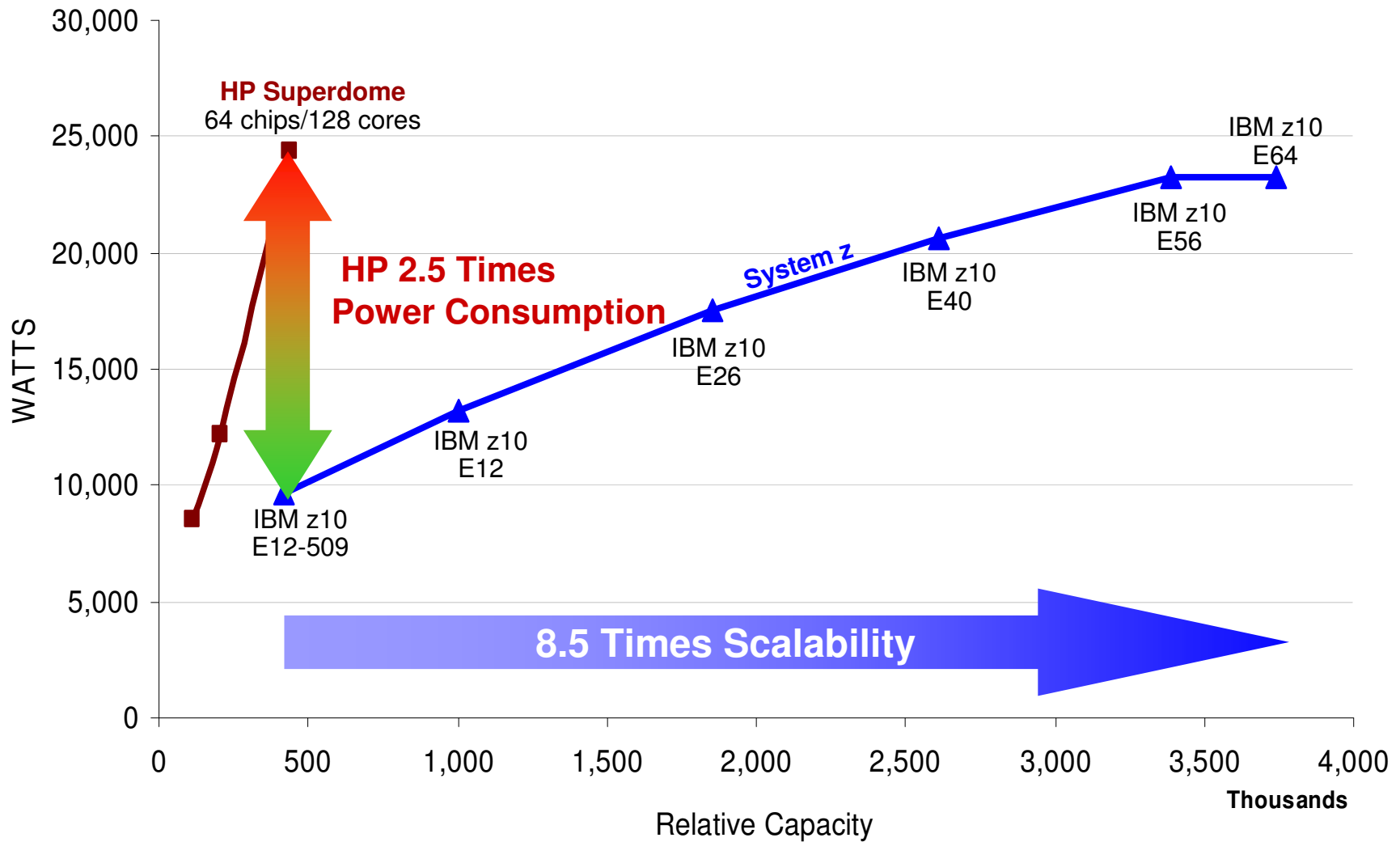# *"PRA" - a study for IBM zSeries customers*

- ➢ helps understand the potential impact of processing growth on future software budgets by developing predictive costs models.

- ➢ provides you with a comparison of your current portfolio cost structure with those of other zSeries/S390 customers.

- ➢ analyzes your software portfolio to identify redundant or underutilized software products.

- ➢ identifies product alternatives and their cost/ benefit impact.

- ➢ provides you with negotiation leverage with incumbent product vendors.

- ➢ provides you with the latest Software Asset Management tips to help proactively manage your zSeries/S390 software portfolio

http://www-3.ibm.com/software/solutions/softwaremigration/sps.html
Or contact Linda Beckner at (614) 659-7192 or at Becknel@us.ibm.com.

z10 Consumes Less Power Than Superdome

HP Superdome
64 chips/128 cores

**HP 2.5 Times
Power Consumption**

System z

IBM z10
E26

IBM z10
E12

IBM z10
E12-509

IBM z10
E40

IBM z10
E56

IBM z10
E64

WATTS

30,000

25,000

20,000

15,000

10,000

5,000

0

8.5 Times Scalability

0   500   1,000   1,500   2,000   2,500   3,000   3,500   4,000

Relative Capacity

Thousands

Do The Math
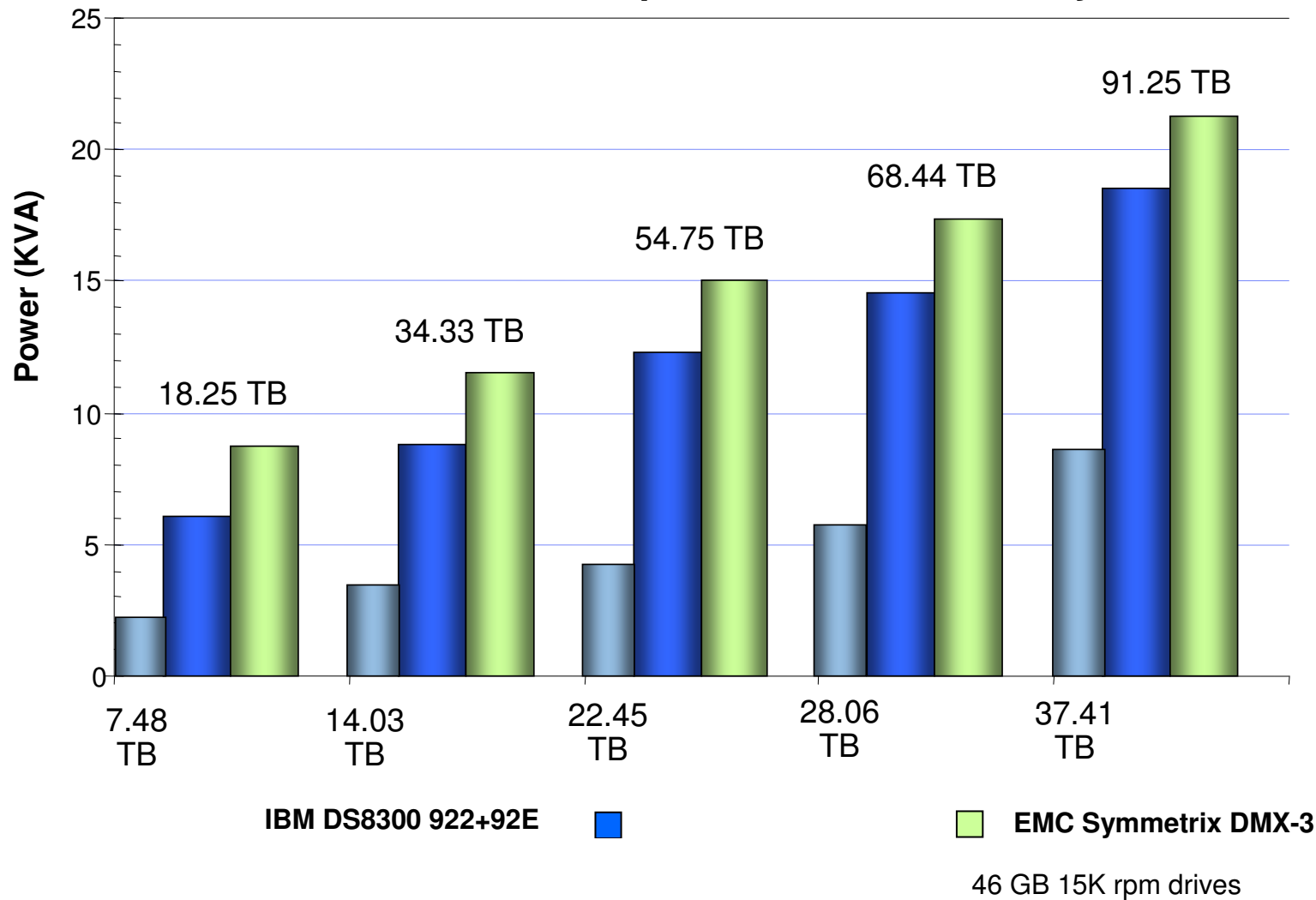
- HP Itanium 2 Superdome 9050 (64ch/128co)* consumes a maximum of 24,392 watts
  - ▸ [24,392 X $.10 X (24 X 365)]/1000 = $21,367 per year for electricity

- Mainframe with similar computing capacity - a System z10 704 machine with 2 I/O cages using 13.26 kW (rated)*
  - ▸ $11,615 per year for electricity

- Similar savings on cooling capacity
  - ▸ Cost of cooling is about 60% additional
  - ▸ Superdome total $34,187 per year vs. Mainframe $18,585
  - ▸ Savings of mainframe power and cooling is $15,602 per year

* Performance equivalence determined by IBM TCO study

IBM Storage Also Saves Energy Costs

IBM DS8300 Power Consumption vs. EMC DMX-3 by Size

Power (KVA) chart showing comparison at different sizes:
- 18.25 TB
- 34.33 TB
- 54.75 TB
- 68.44 TB
- 91.25 TB

X-axis values: 7.48 TB, 14.03 TB, 22.45 TB, 28.06 TB, 37.41 TB

IBM DS8300 922+92E ■   **EMC Symmetrix DMX-3** ■

46 GB 15K rpm drives

The Mainframe Also Delivers More Compute Power Per Footprint Unit

Performance Units per Square Foot

Legend: ■ SUN ■ HP ■ IBM

Chart: Performance Units (y-axis, 0 to 50,000) vs Approximate footprint (sq ft) (x-axis)

- 22 Sun Fires (5.8)
- HP 9050 16/32 (10)
- IBM z10-705 (30.4)
- 157 Sun Fires (29)
- HP 9050 32/64 (10)
- IBM z10-711 (30.4)
- 319 Sun Fires (52.2)
- HP 9050 64/128 (20)
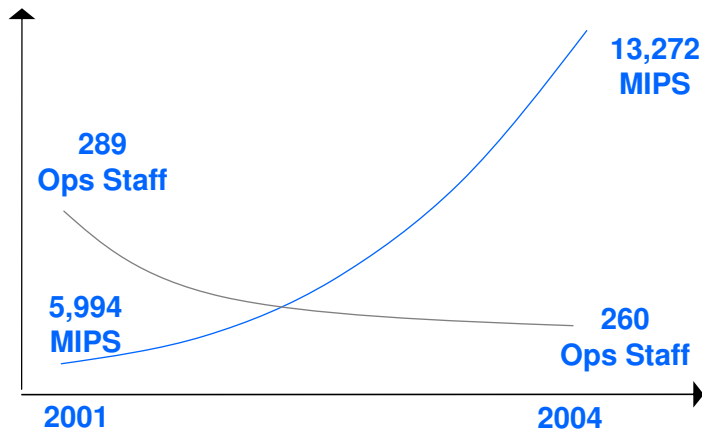- IBM z10-717 (30.4)

Approximate footprint (sq ft)
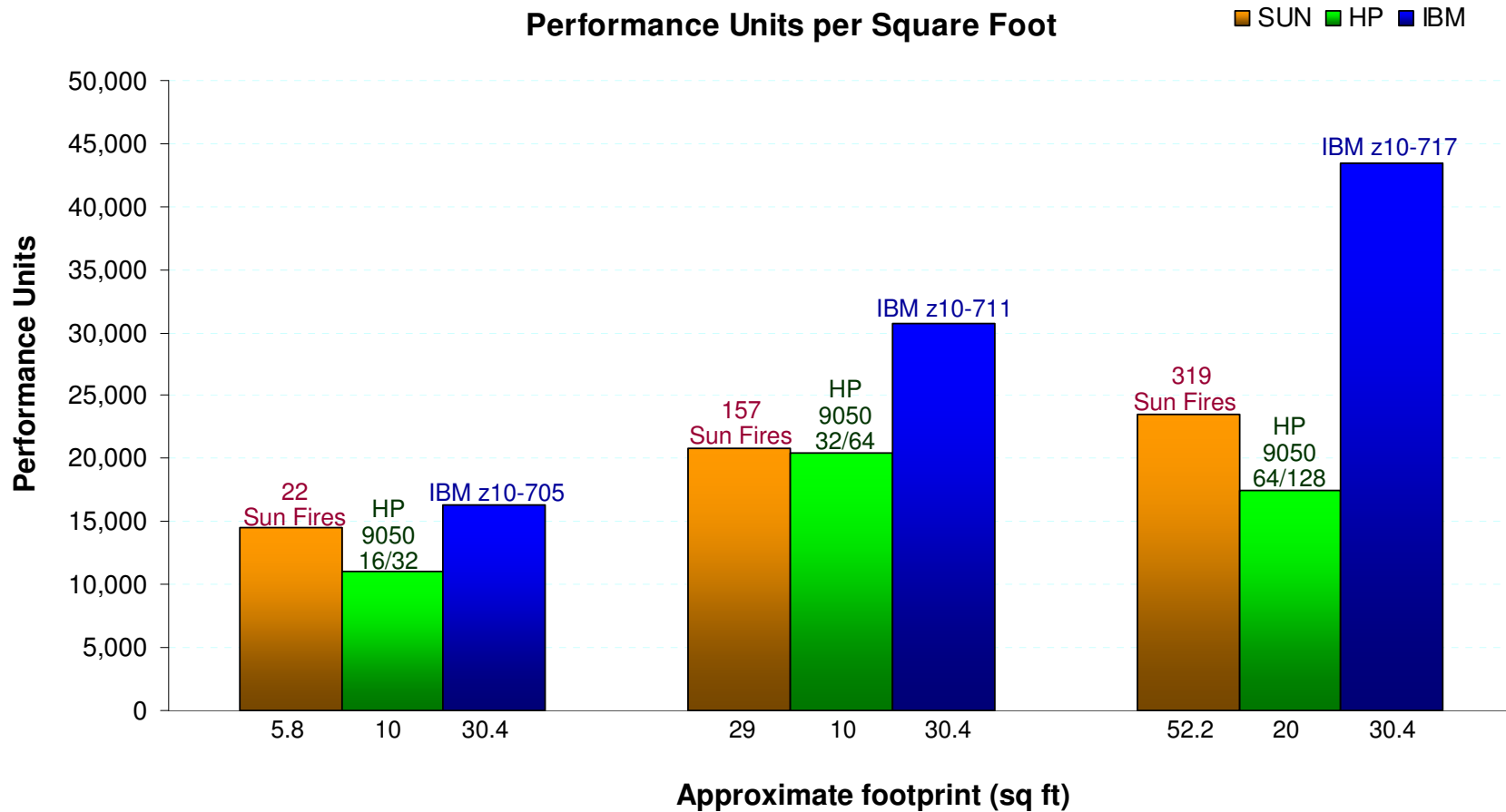
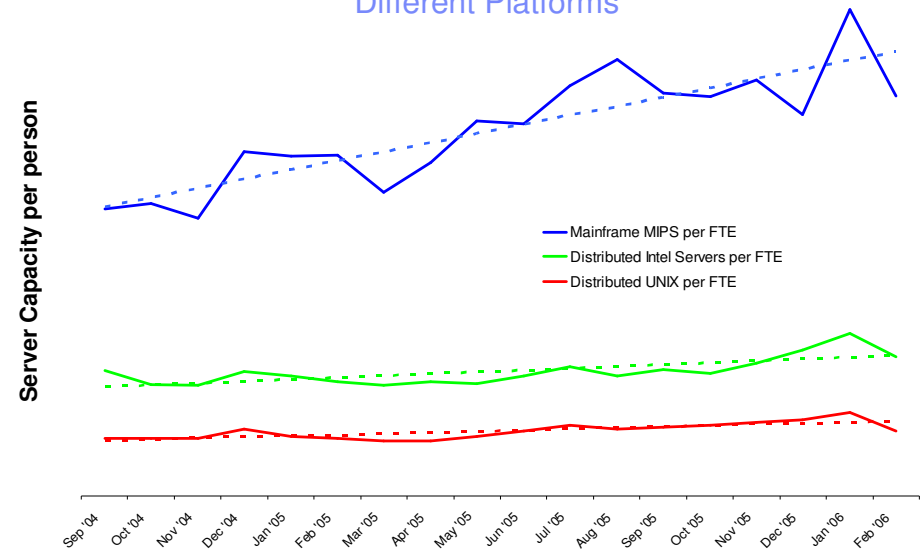Based on 122 performance units per MIP

Mainframe footprint remains constant

Mainframe Labor Costs Are Going Down

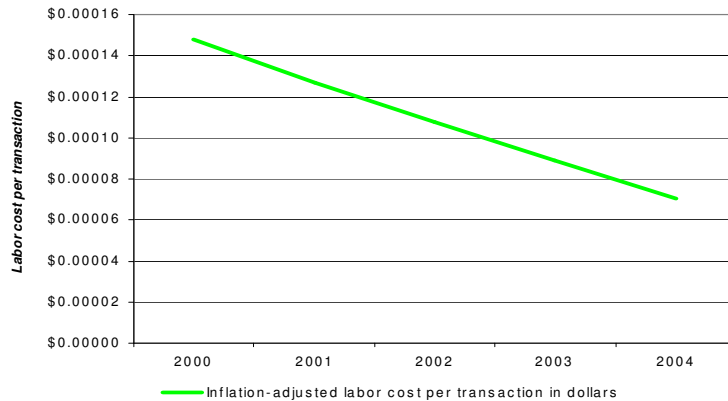**Data Center Staffing Levels for System z Have Not Increased Despite Large Increase in MIPS**

13,272 MIPS

289 Ops Staff

5,994 MIPS

260 Ops Staff

2001   2004

Hardware Managed Per Person for Different Platforms

Server Capacity per person

— Mainframe MIPS per FTE
— Distributed Intel Servers per FTE
— Distributed UNIX per FTE

Sep '04 Oct '04 Nov '04 Dec '04 Jan '05 Feb '05 Mar '05 Apr '05 May '05 Jun '05 Jul '05 Aug '05 Sep '05 Oct '05 Nov '05 Dec '05 Jan '06 Feb '06

Labor Cost Per Transaction on System z is Decreasing

Labor cost per transaction

$0.00016
$0.00014
$0.00012
$0.00010
$0.00008
$0.00006
$0.00004
$0.00002
$0.00000

2000   2001   2002   2003   2004

— Inflation-adjusted labor cost per transaction in dollars

First National Bank of Omaha

	Servers	Reliability	Utilization	Staff
First move: Implemented distributed computing architecture that became **too difficult to monitor, maintain, upgrade and scale**	▪ 30+ Sun Solaris servers ▪ 560+ Intel ser	Un-acceptable	12%	24 people growing at 30% year
Next move: Consolidated back on the mainframe	z990	Much improved	84% with additional reserve capacity **on-demand**	Reduced to 8 people

Staff growth reversed by consolidating to the mainframe

Customer Survey – How Many People to Manage Servers?

# NT Servers	# People	Ratio (s/p)
1123	68	16.5
228	20	14.4
671	51	13.1
700	65	11.5
154	18	8.5
431	61	7.1
1460	304	4.8
293	79	3.7
132	54	2.0

# UNIX Servers	# People	Ratio (s/p)
706	99	7.1
273	52	5.2
69	15	4.6
187	56	3.3
170	51	3.3
85	28	3.0
82	32	2.6
349	134	2.6
117	50	2.3
52	52	1.0

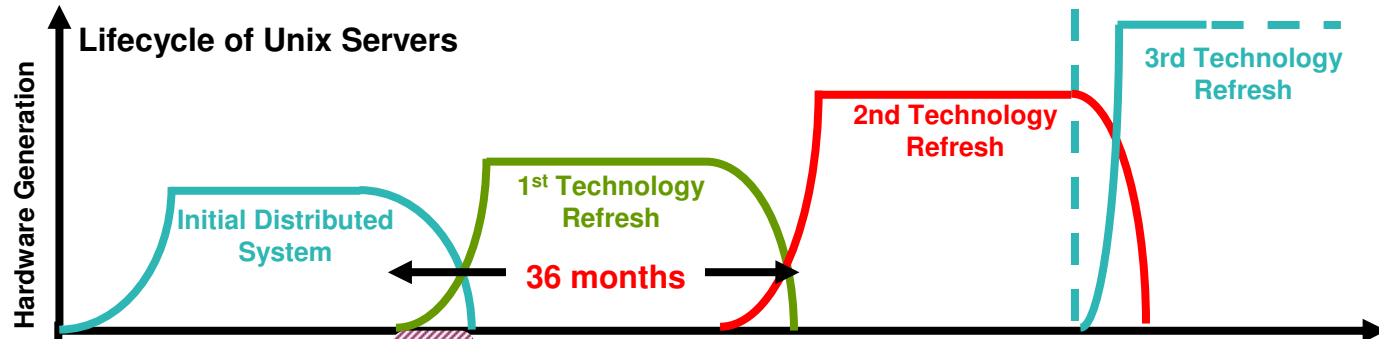Mainframe administration productivity surveys range 167-625 MIPS per headcount   (500 is typical), so…

Source: IBM Scorpion Customer Studies NOTE: Figures for total administration cost

Manage More Workload Per Headcount

RPEs per Administrative Headcount

Chart showing RPEs per Administrative Headcount:
- Dell Poweredge: 25280
- HP Proliant: 13230
- IBM S38: 61000

4x more workload per person (from HP Proliant to IBM S38)

Legend:
- Dell Poweredge
- HP Proliant
- IBM S38

Compared at 122 RPE's = 1 MIP
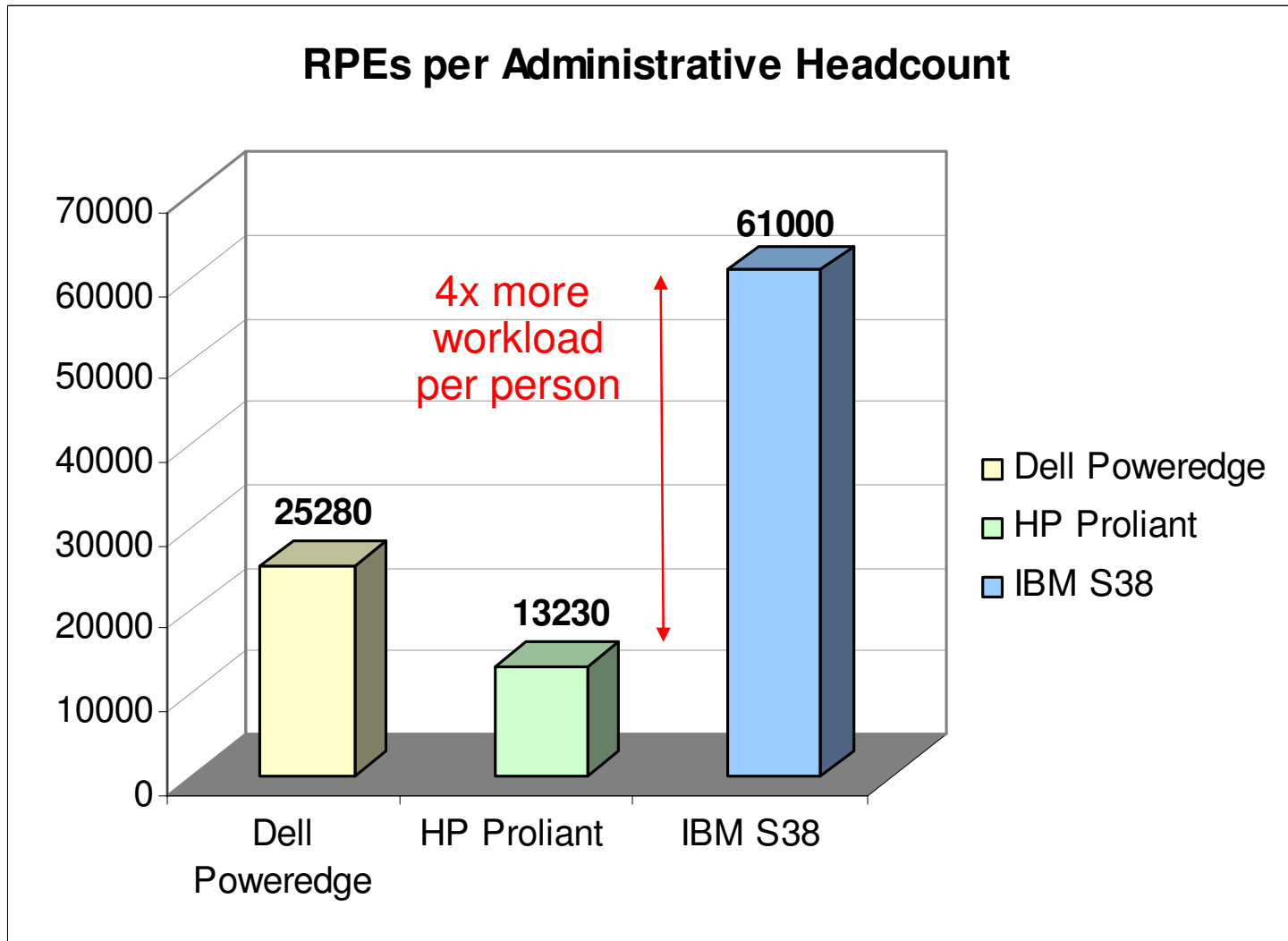
New York Financial Services Company – Useful Lifetime Of 36 Month Lease

Lifecycle of Unix Servers

Hardware Generation

Initial Distributed System

1st Technology Refresh

2nd Technology Refresh

3rd Technology Refresh

36 months

6 months provisioning

30 months production

Setup and tear down 15 People, 5 full time

Lifecycle of Mainframe Generations

Hardware Generation

36 months

36 months

36 months

Initial Mainframe System

1st Technology Refresh

2nd Technology Refresh

1 Weekend upgrading to new hardware and software levels

36 months production

No need to retire the server, upgrade in place

Observed at a large financial service customer

In each 36 month lease there are only 30 months production use

Setup and tear-down time costs 25% more. Plus . . . 41 hours of FTE setup and tear down labor per server = $3,075
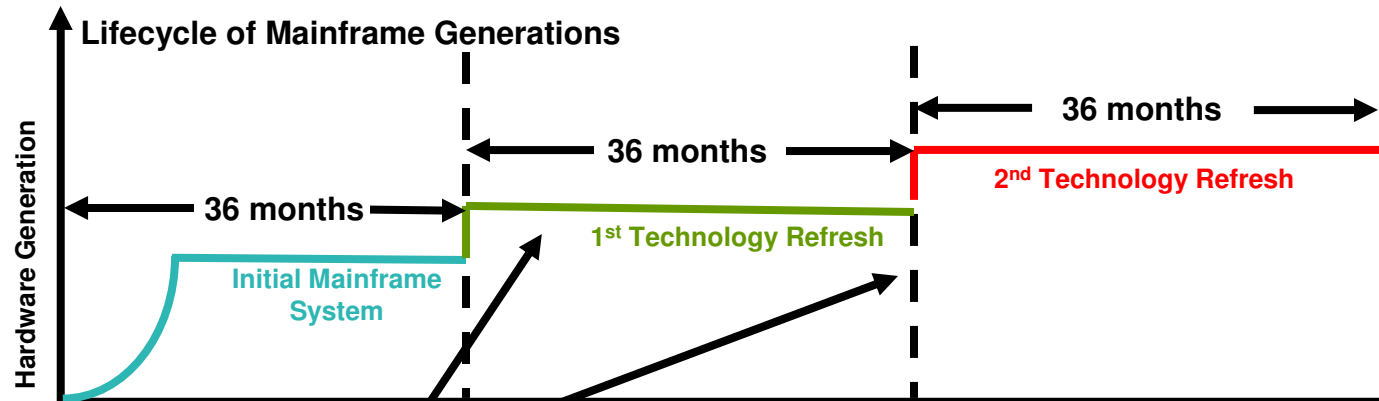
Weekend upgrades performed by IBM
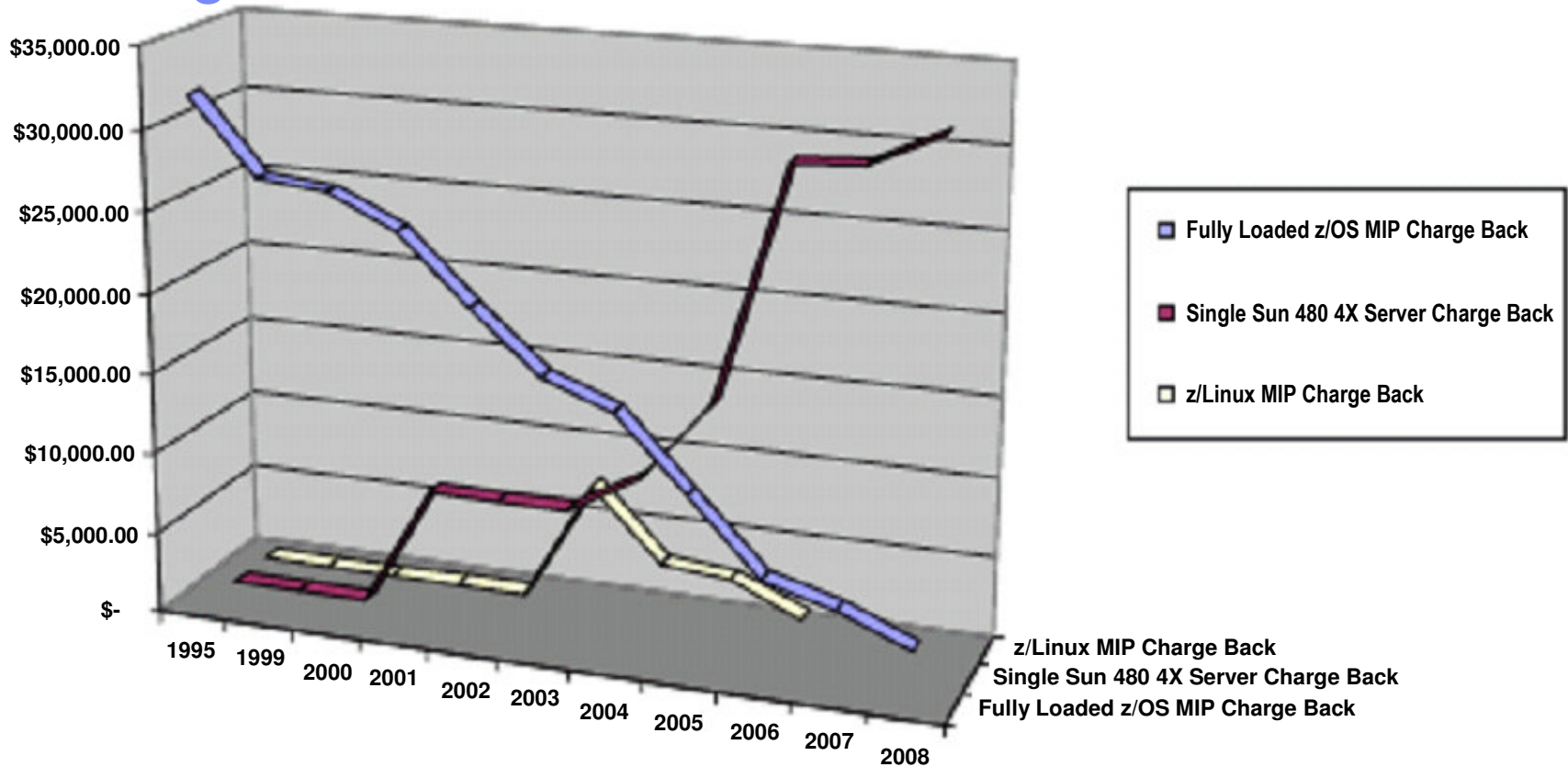
Capacity on demand pricing

Charge Back Practices Were Improved Over Time at a Large Financial Institution

Fully Loaded z/OS MIP Charge Back

Single Sun 480 4X Server Charge Back

z/Linux MIP Charge Back

More Accurate Charge Back Can Correct Perceptions of Relative Costs

Understand The Cost Components

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

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

Source: IBM internal study

Key Points:

Mainframe Costs	Distributed Costs
The cost of running incremental workload on the mainframe goes down as the total workload grows	The cost of running additional workload on distributed servers goes up more linearly
▶ Labor costs hold steady as workload grows	▶ Labor is now the highest cost element in distributed environments Administrative staff costs increase in proportion to the number of servers
▶ IBM pricing policies designed to favor the addition of more workload	▶ New workload requires additional servers and licenses
▶ Highly Efficient Power and Cooling – Small Footprint	▶ Energy and Space cost is more linear
▶ Lower software costs per transaction as workload grows – and PRA can lower ISV tool costs	▶ Cost of software licenses is more linear
▶ High Availability and Security Translate into low cost	▶ Fractionally less Availability and Security can drive Significant downstream costs
Customers have learned that mainframes deliver economies of scale, especially as the workload grows	**Result – scale out strategies do not deliver equivalent economies of scale as the workload grows**

This pricing discussion uses published list prices

Case Study: Consolidate On Mainframe vs. Keeping Dedicated Servers

Mainframe Incremental Hardware

OTC		ANNUAL	
3 IFL Processors	$375,000	Processor [2] Maintenance	$52,524
		Power/Space [1]	$47,073
Conn. + Disk Acquisition	$639,033	Conn. + Disk Maintenance [1]	$87,480
RAM (190GB)	$1,140,000	System Admin [1]	$386,518
Migration	$4,920,492	On-Premise Network Maintenance [1]	$8,935
TOTAL	$7,074,525	TOTAL	$582,530 (year 2, 3)

Mainframe Software

OTC		ANNUAL	
z/VM	$67,500	z/VM [2]	$16,890
		Oracle S&S [2]	$26,400
		Linux S&S [1]	$45,000
TOTAL	$67,500	TOTAL	$88,290 (year 2, 3)

Dedicated Hardware

OTC		ANNUAL	
Sunk Cost	$0	Disk Maintenance [1]	$59,276
		Server maintenance [1]	$226,884
		Off-Premise Network [1]	$299,008
		Power/Floorspace [1]	$501,656
		System Admin [1]	$5,944,828
		On-Premise Network Maintenance [1]	$62,196
TOTAL	$0	TOTAL	$7,093,848

Dedicated Software

OTC		ANNUAL	
Sunk Costs	$0	Oracle S&S [1]	$2,569,600
		Linux S&S [1]	$379,308
TOTAL	$0	TOTAL	$2,948,908

1 – Needs three years maintenance, 2 – Needs two years maintenance