IBM®

The future runs on System z

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
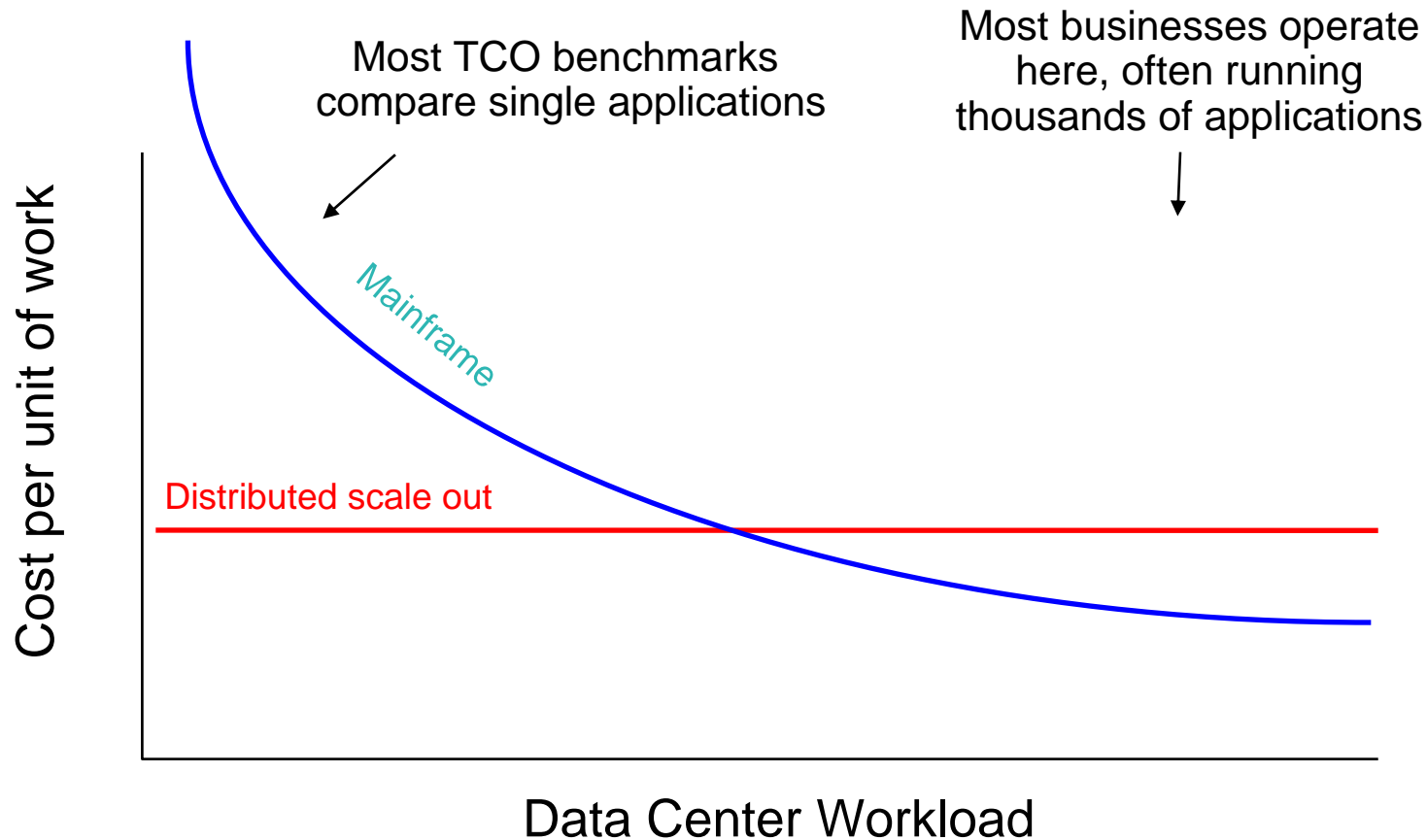
+ Environmentals

+ Labor

+ required Quality-of-Service

(Availability, Security, Disaster/Recovery…)
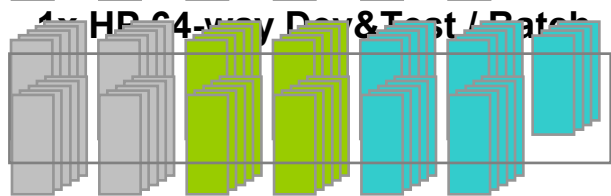
+ other Elements

(Chargeback)

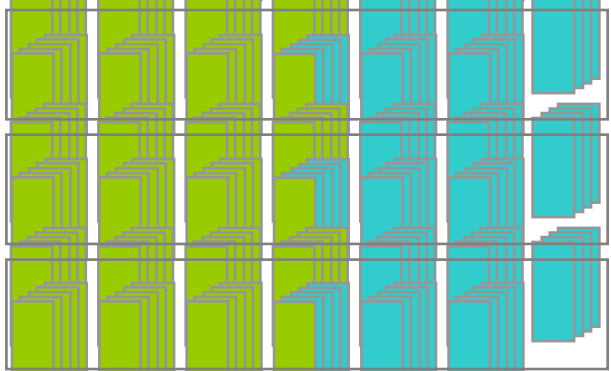_The total cost requires a total picture of your I/T assets and expenses_

Mainframe Cost/Unit of Work Decreases as Workload Increases

Most TCO benchmarks compare single applications

Most businesses operate here, often running thousands of applications

Mainframe

Distributed scale out

Cost per unit of work

Data Center Workload

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

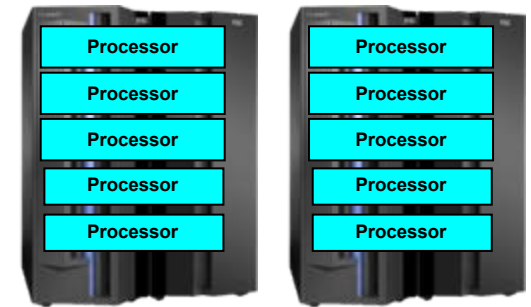**3x HP 64-way Production Application and DB**

1x HP 64-way Dev&Test / Batch

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

*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

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

122 RPE's per MIP

Some disaster recovery

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

Idle Resource

Idle Resource

Workload

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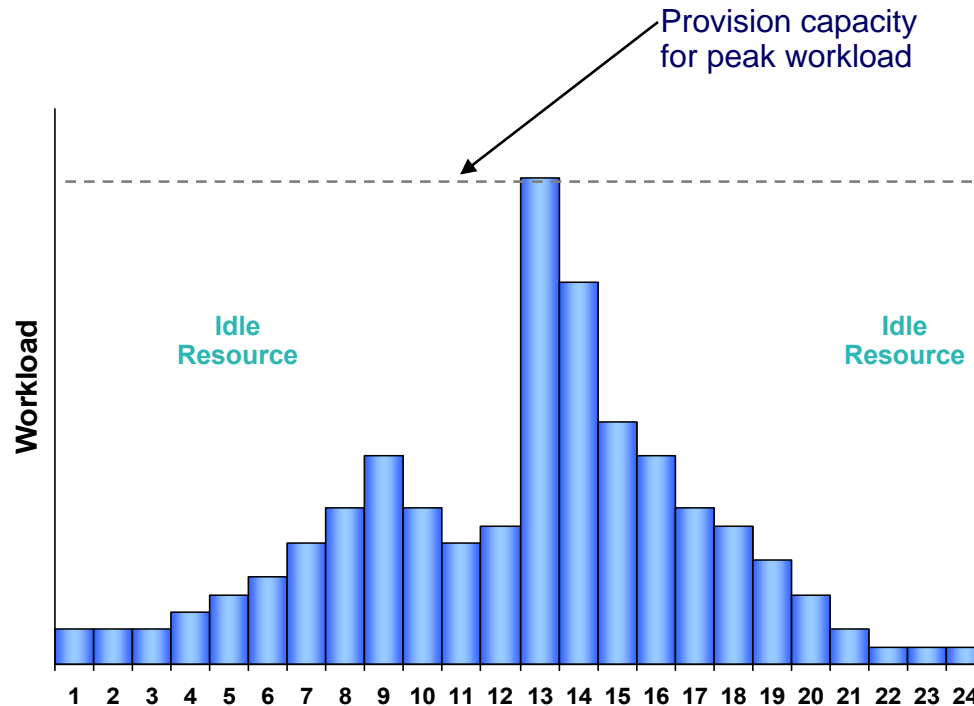

- **Storage Allocation**
  - Application-specific resulting in over-allocations
  - Fine grained storage allocation mechanisms characteristic of mainframe storage are uncommon in distributed environments.

- **Storage Utilization**
  - Single digit utilization for distributed environments is not uncommon
  - Storage utilization of 80% + is typical for mainframe
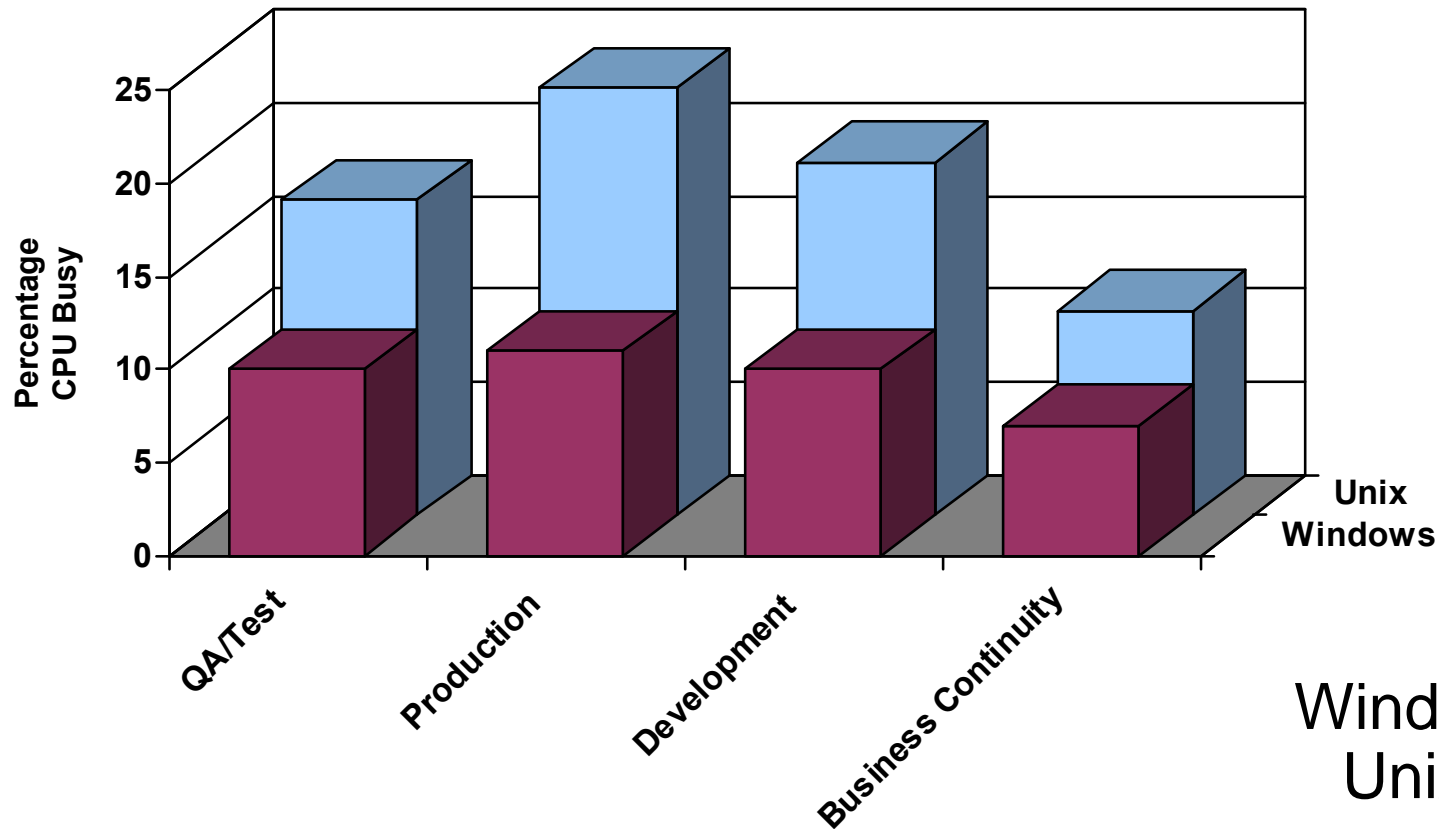
- **Storage Management**
  - Data disaster recovery, synchronization, and transfer requirements add complexity and cost

Application specific storage allocations tend to occur in large units…

resulting typically in single digit utilization
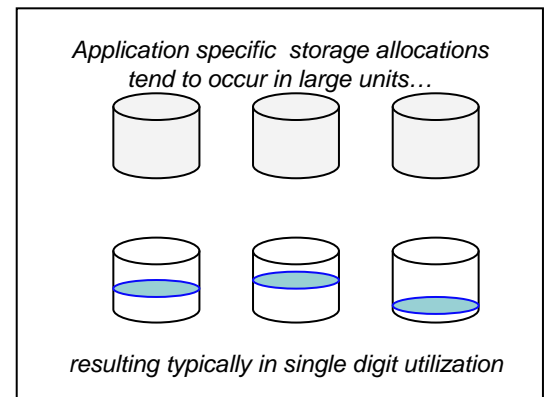
Server Utilization at a Large Financial Institution

Average Server Utilization by Class
Feb-06

Windows 5-10%
Unix 10-20%

System z With DB2 Scales Further Than Best HP Superdome Banking Benchmark

Asian Bank
- ▶ **IBM System z9 and DB2**
- ▶ **TCS BaNCS (Cobol)**
- ▶ **15,353** Transactions/second
- ▶ **50** Million Accounts
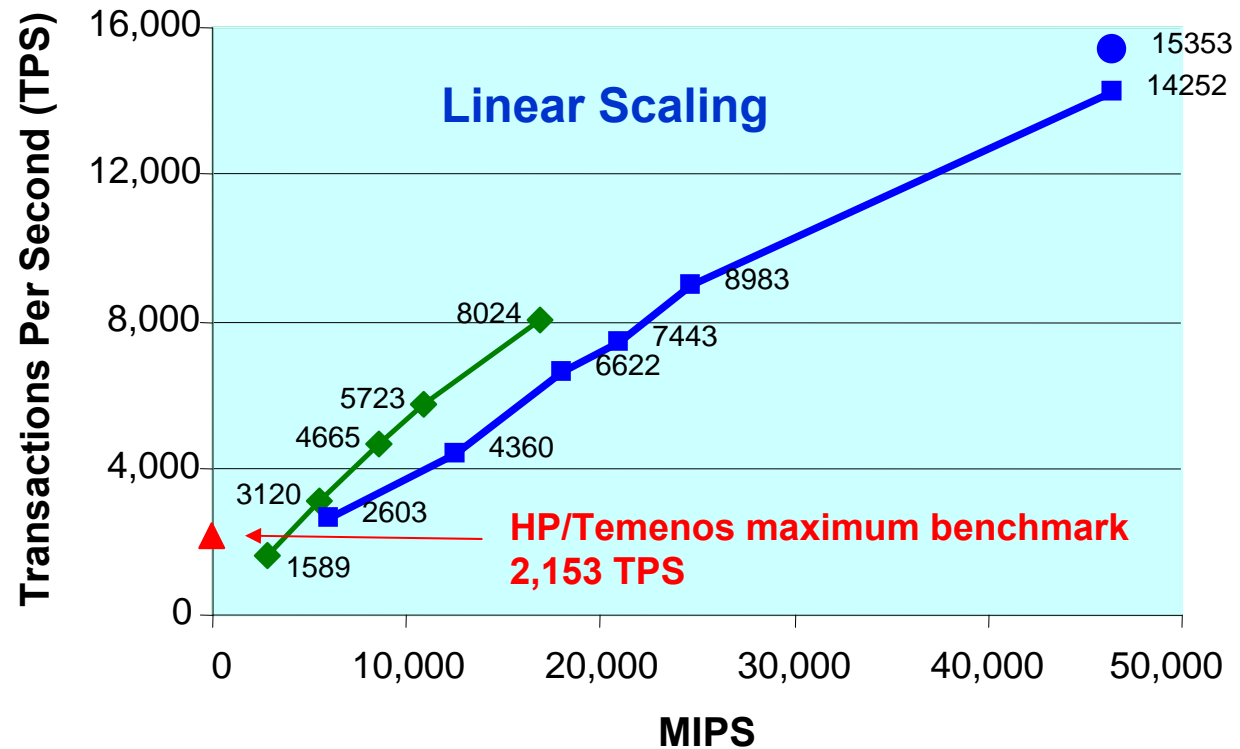- ▶ IBM benchmark for customer

Bank of China **
- – **IBM System z9 and DB2**
- – **TCS BaNCS (Cobol)**
- – **8024***** Transactions/second
- – **380** Million Accounts
- – IBM benchmark for customer

HP/Temenos *
- – **HP Itanium**
- – **Temenos T24 (Java)**
- – **2,153** Transactions/second
- – **13** Million Accounts
- – Largest banking benchmark performance claimed by HP

System z and BaNCS Online Banking Benchmarks

Transactions Per Second (TPS) vs **MIPS**

Linear Scaling

Data points (green line): 1589, 3120, 4665, 5723, 8024
Data points (blue line): 2603, 4360, 6622, 7443, 8983, 14252
Blue dot: 15353

HP/Temenos maximum benchmark 2,153 TPS

Y-axis: 0, 4,000, 8,000, 12,000, 16,000
X-axis: 0, 10,000, 20,000, 30,000, 40,000, 50,000

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 transaction per Processor

Instructions per Transaction per Processor

- 3,000,000
- 2,500,000
- 2,000,000
- 1,500,000
- 1,000,000
- 500,000
- 0

4.9 times instruction expansion

2,408,135

489,843

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
- 15,000,000
- 10,000,000
- 5,000,000
- 0

12.6 times cycle expansion

20,532,959

1,634,335

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
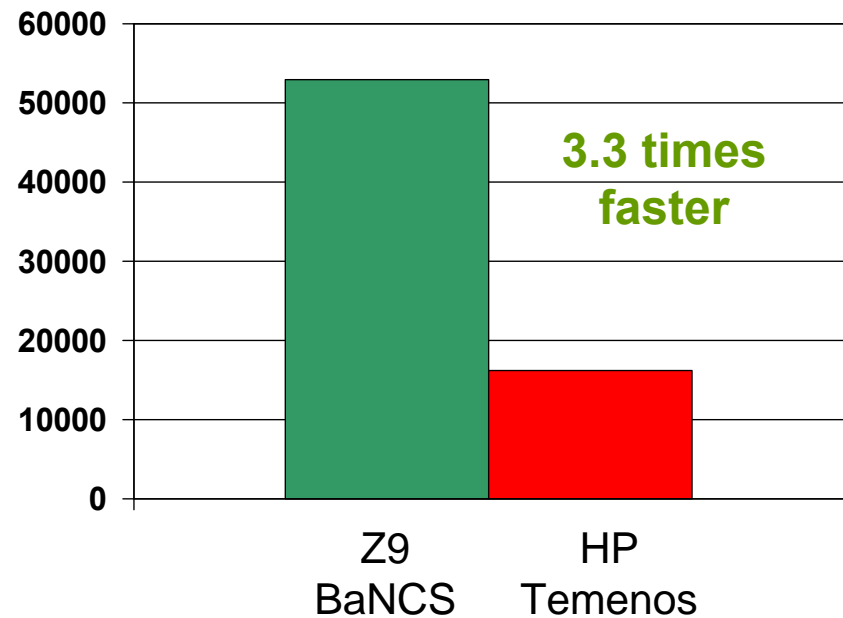4 X 1.428 GHz
64 GB RAM**

Source: SWG Internal Measurements

System z Batch Processing Performance

- 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
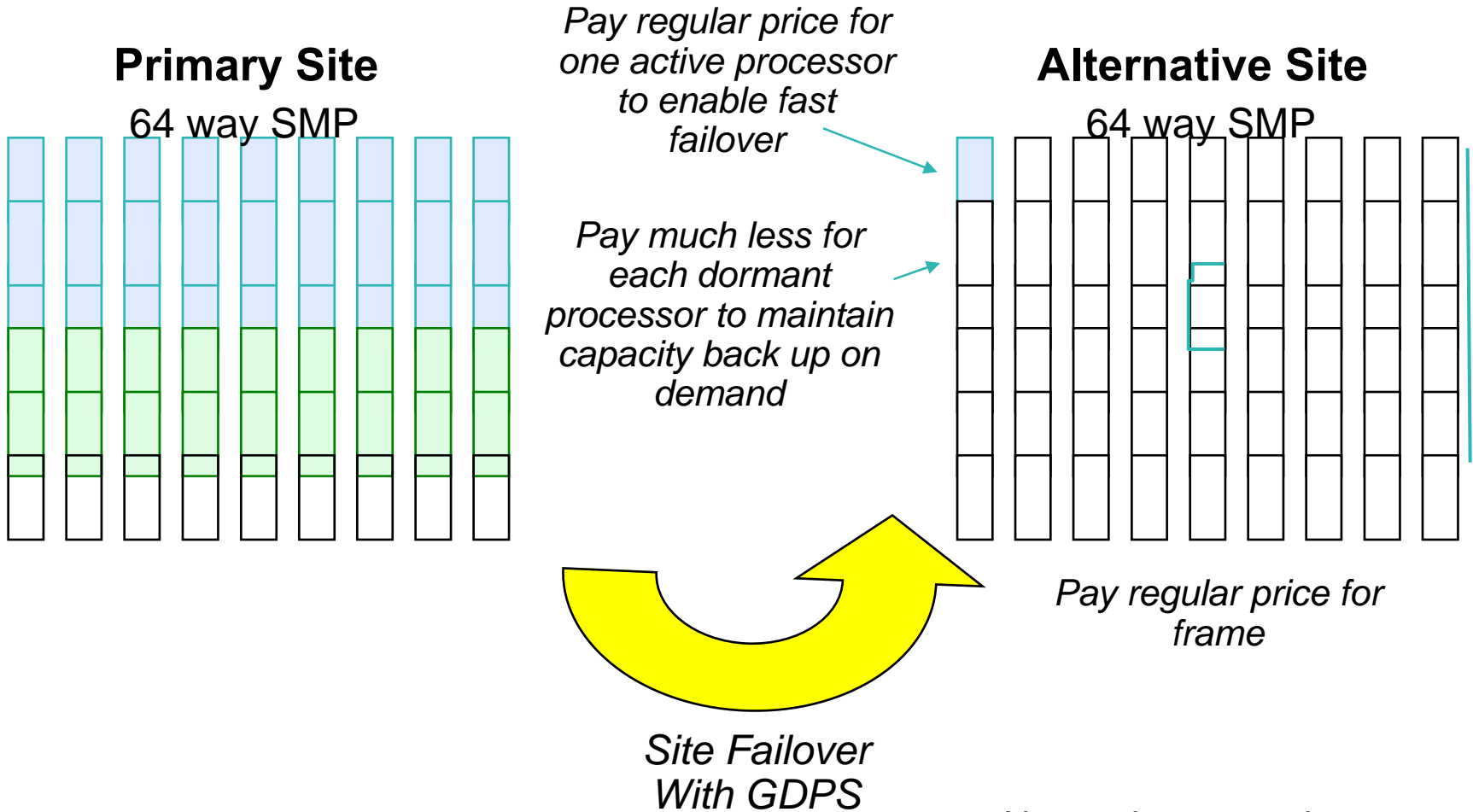 - End of Day processing finished in 13.33 minutes (16,250 accounts/second)

End of Day Batch Processing Accounts Per Second

3.3 times faster

Chart:
- Z9 BaNCS: ~53000
- HP Temenos: ~16250

Y-axis: 0, 10000, 20000, 30000, 40000, 50000, 60000

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: Québec 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

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	$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

Observed Consolidation Ratios

A little consolidation is good

More consolidation is better

Cost Per Image

VMware Intel

Power Systems

System z

N →
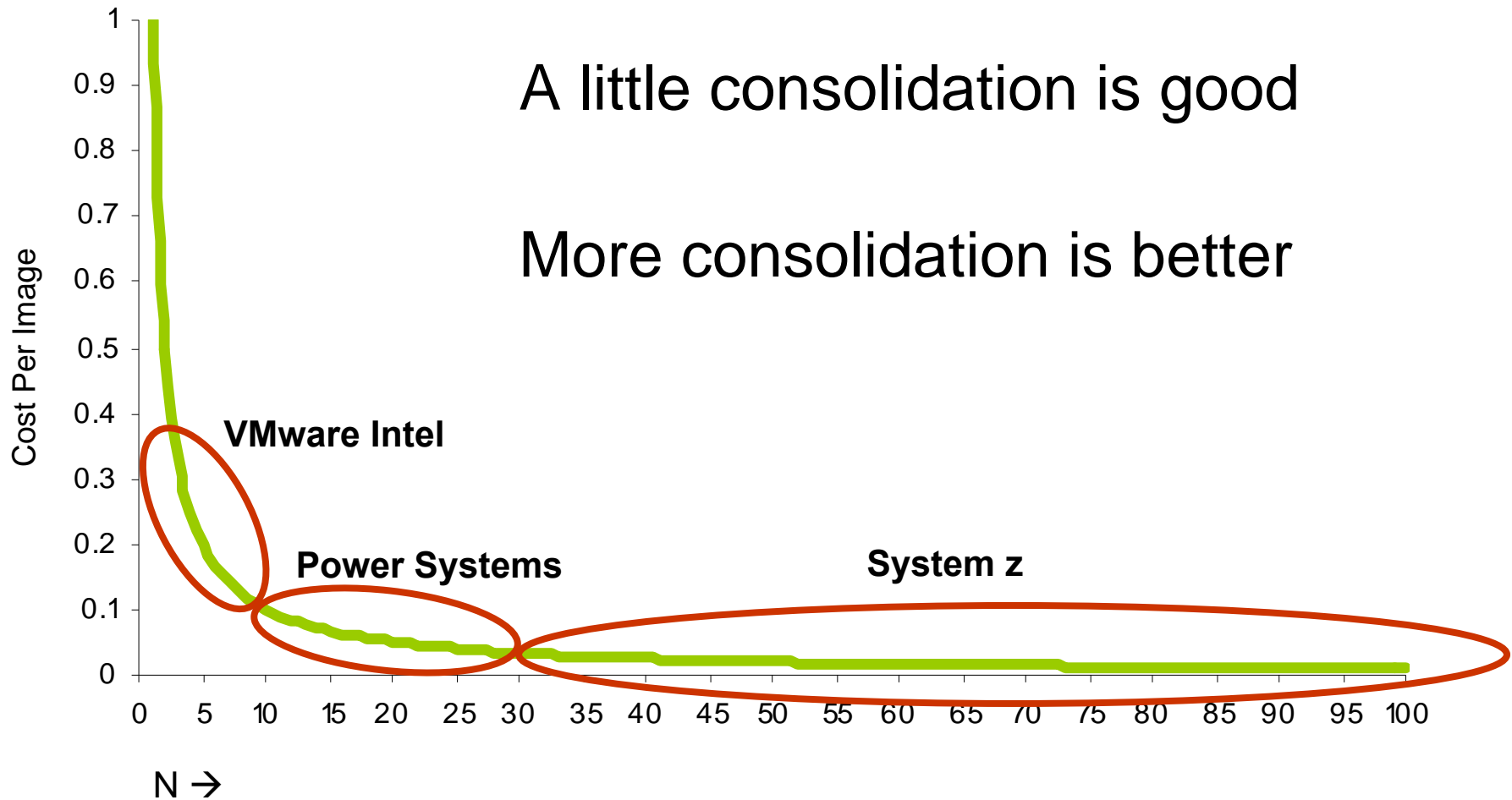
Storage Costs:
DB2 Provides More Storage Savings than Oracle

- **DB2 for z/OS lowers TCO by reducing storage needed**
  - TPC-H Benchmark: DB2 compression of 59% vs 29% for Oracle RAC

- **Storage savings with DB2 vs. Oracle for a 10TB data base**

|	Oracle	DB2 for z/OS*
Storage System	**HP Enterprise Virtual Array 8100 Storage**	**IBM System Storage DS6800**
Overall database compression ratio **(using TPC-H benchmark results)**	**29%**	**59%**
For 10 TB uncompressed data storage needed	**7.5 TB of HP Storage**	**4.2 TB of IBM Storage**
Cost of storage (3 year TCA)	**$319,270 + $15,113 x 3** = $364,609	**$234,101 + $13,164 x 2**** = $260,429
With compression, storage for DB2 costs <u>29% less</u> than for Oracle		

*DB2 for z/OS achieves similar compression ratios to those of DB2 for LUW
**IBM storage maintenance fee for the first year is included in the warranty

Case Study: Network Before Consolidation (292 Servers To 1 System z)

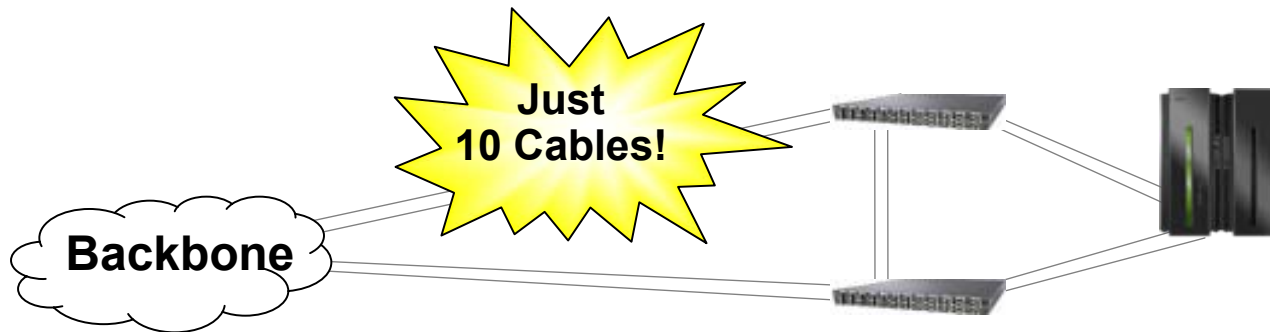|	
Catalyst 3560E-24TD – 24 ports 1gbps	25
Catalyst 3560E-12D – 12 ports 10gbps	6
50 Ft UTP Cable	584
10GB Eth Fiber Cable	60

The diagram shows only **30** of the **292** Servers

Over 600 Cables

Backbone
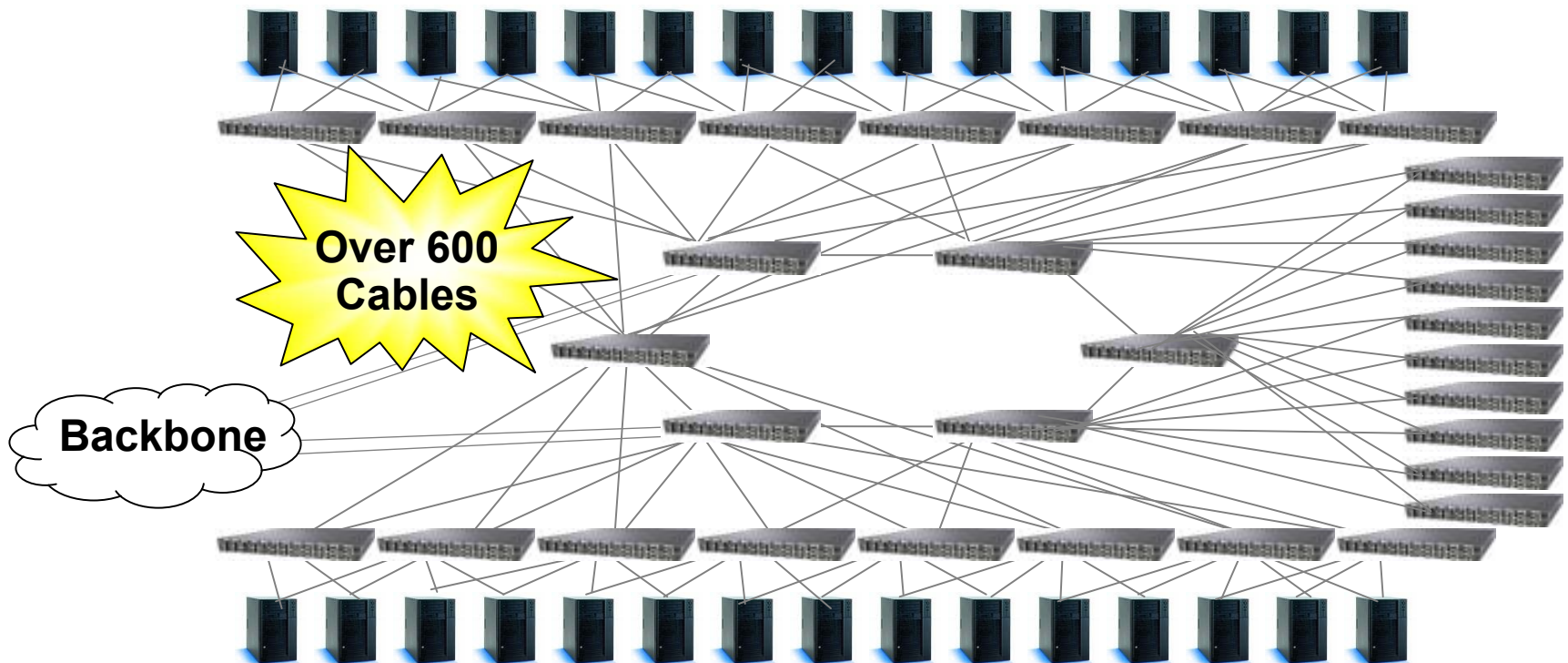
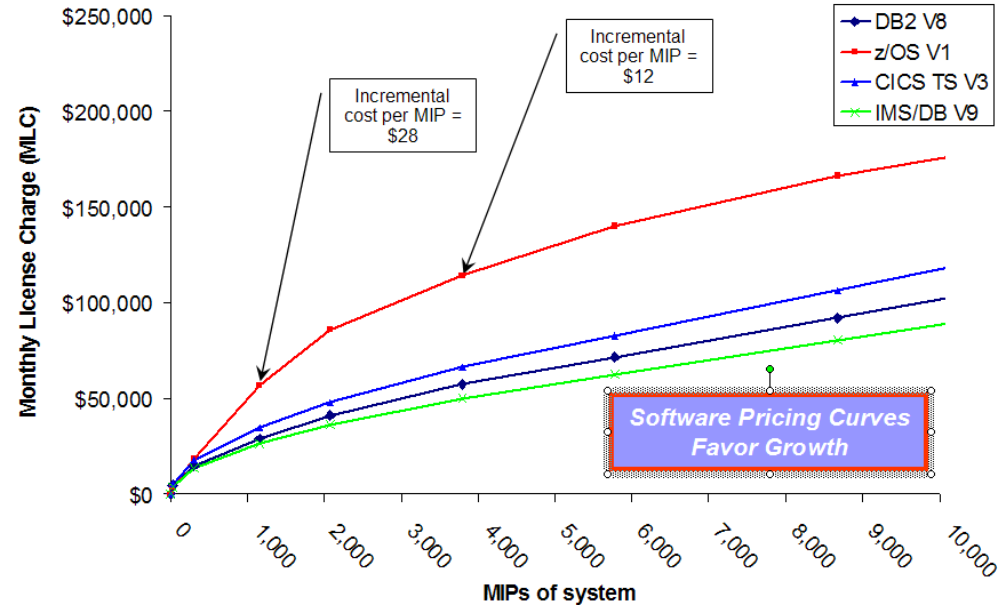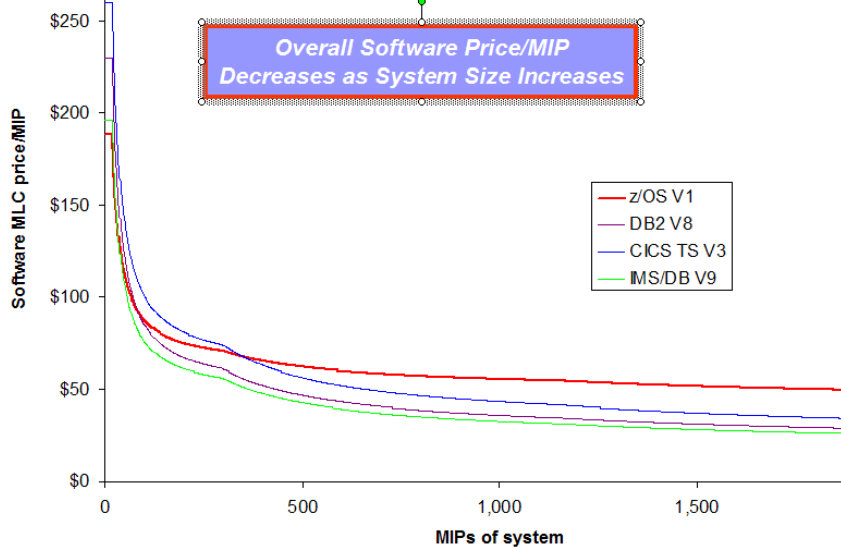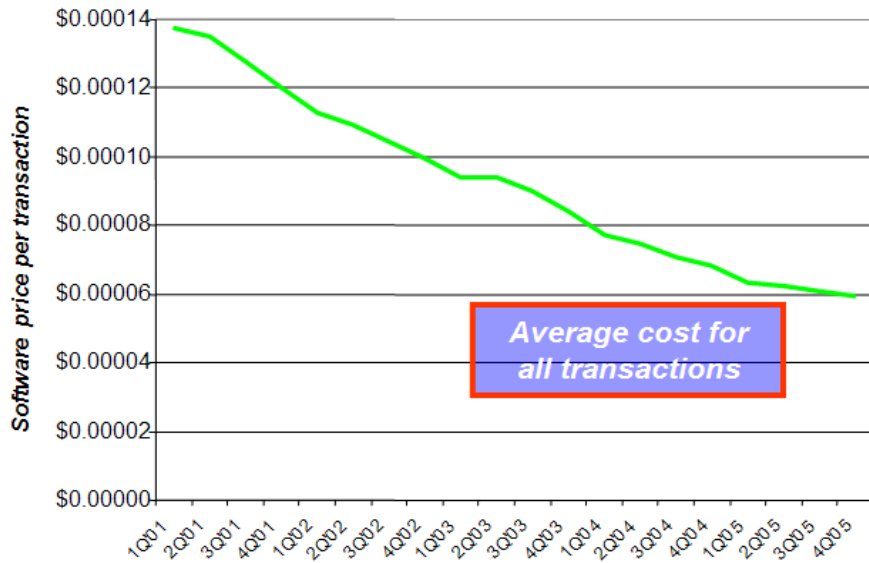# Case Study: Network After Consolidation (292 Servers To 1 System z)

Network Simplification!

Better Performance and Security

Just 10 Cables!

Backbone

IBM Software Price Per Transaction is Going Down

Average cost for all transactions

Overall Software Price/MIP Decreases as System Size Increases

z/OS V1
DB2 V8
CICS TS V3
IMS/DB V9

DB2 V8
z/OS V1
CICS TS V3
IMS/DB V9

Incremental cost per MIP = $28

Incremental cost per MIP = $12

Software Pricing Curves Favor Growth

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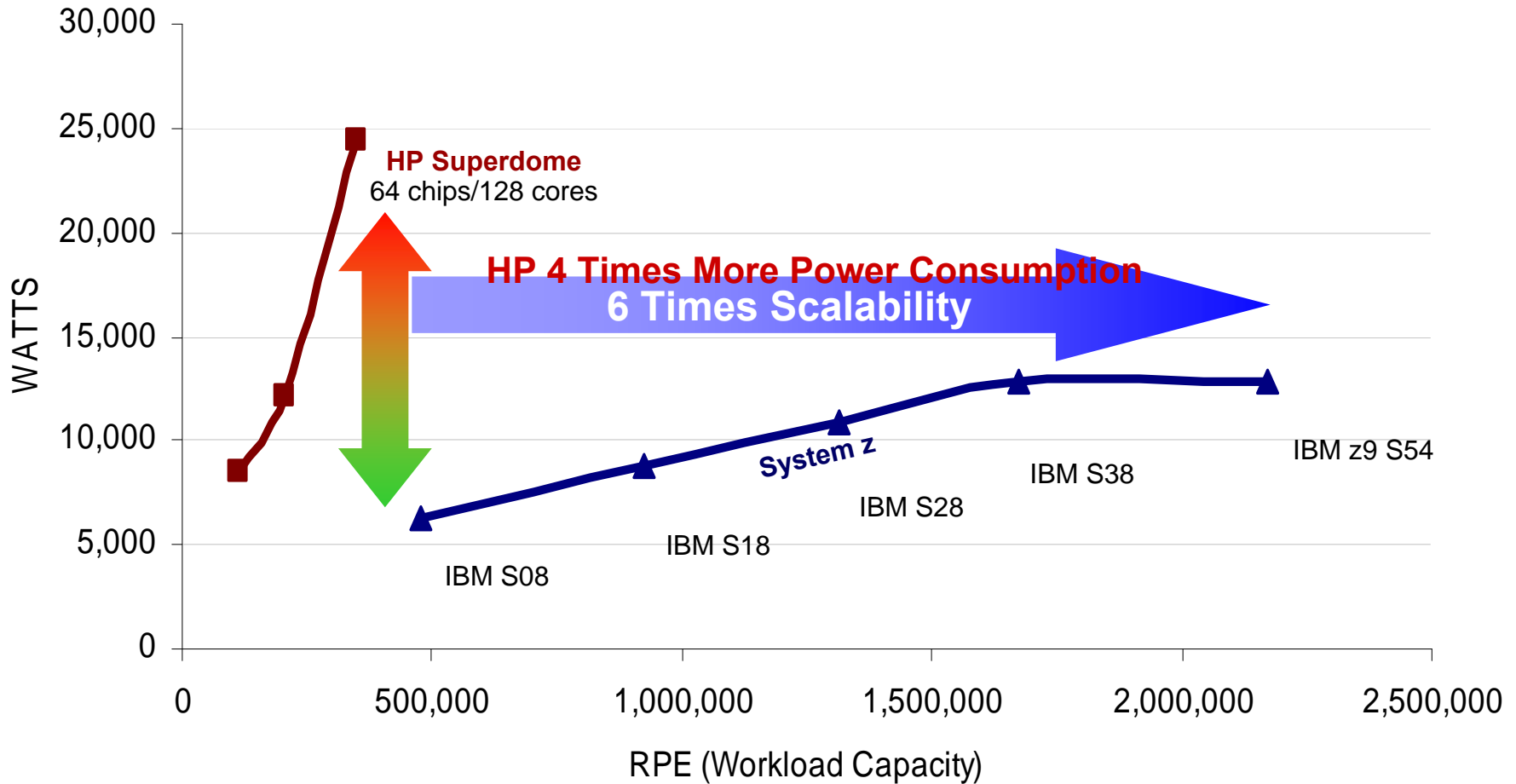
Portfolio Review and Analysis
"PRA" - a study for IBM zSeries customers

➢ **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.

Mainframe Consumes Less Power Than HP Superdome

WATTS vs RPE (Workload Capacity)

- HP Superdome 64 chips/128 cores
- HP 4 Times More Power Consumption
- 6 Times Scalability
- System z
- IBM S08
- IBM S18
- IBM S28
- IBM S38
- IBM z9 S54

Source for HP Servers: Ideas International, Nov 06
Note: Uses equivalence ratio of 122 RPE's per MIP

Do the Math

- **HP Itanium 2 Superdome 9050 (64ch/128co)* consumes a maximum of 24,392 watts**
  - [24,392 X $.09 X (24 X 365)]/1000 = $19,230 per year for electricity

- **Mainframe with similar computing capacity - a System z9 S08 machine using 6.3 kW**
  - $4,967 per year for electricity

- **Similar savings on cooling capacity**
  - Cost of cooling is about 60% additional
  - Superdome total $30,768 per year vs. Mainframe $7947
  - Cost of mainframe power and cooling is $22,821 per year less than HP

*Rated at 350,041 RPE

IBM Storage Also Saves Energy Costs

IBM DS8300 Power Consumption vs. EMC DMX-3 by Size
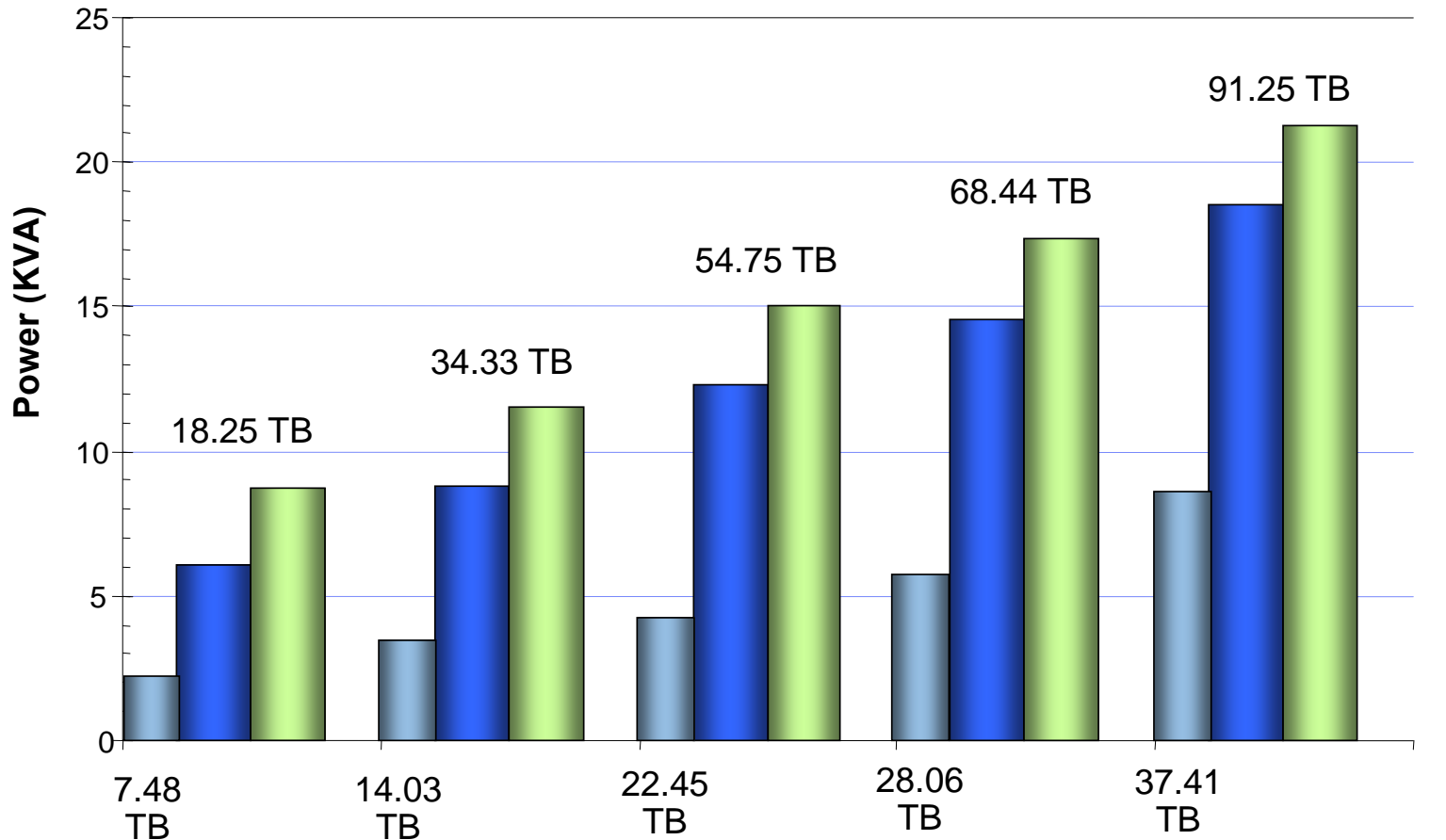
IBM DS8300 922+92E ■   EMC Symmetrix DMX-3 ▨

46 GB 15K rpm drives

An Inconvenient Truth!

Equivalent CO2 Emissions in one year

10,000 sq ft at 125 watts/ft2 @ $.09 per kwH

$985K per year

11,498 tons of CO2 per year

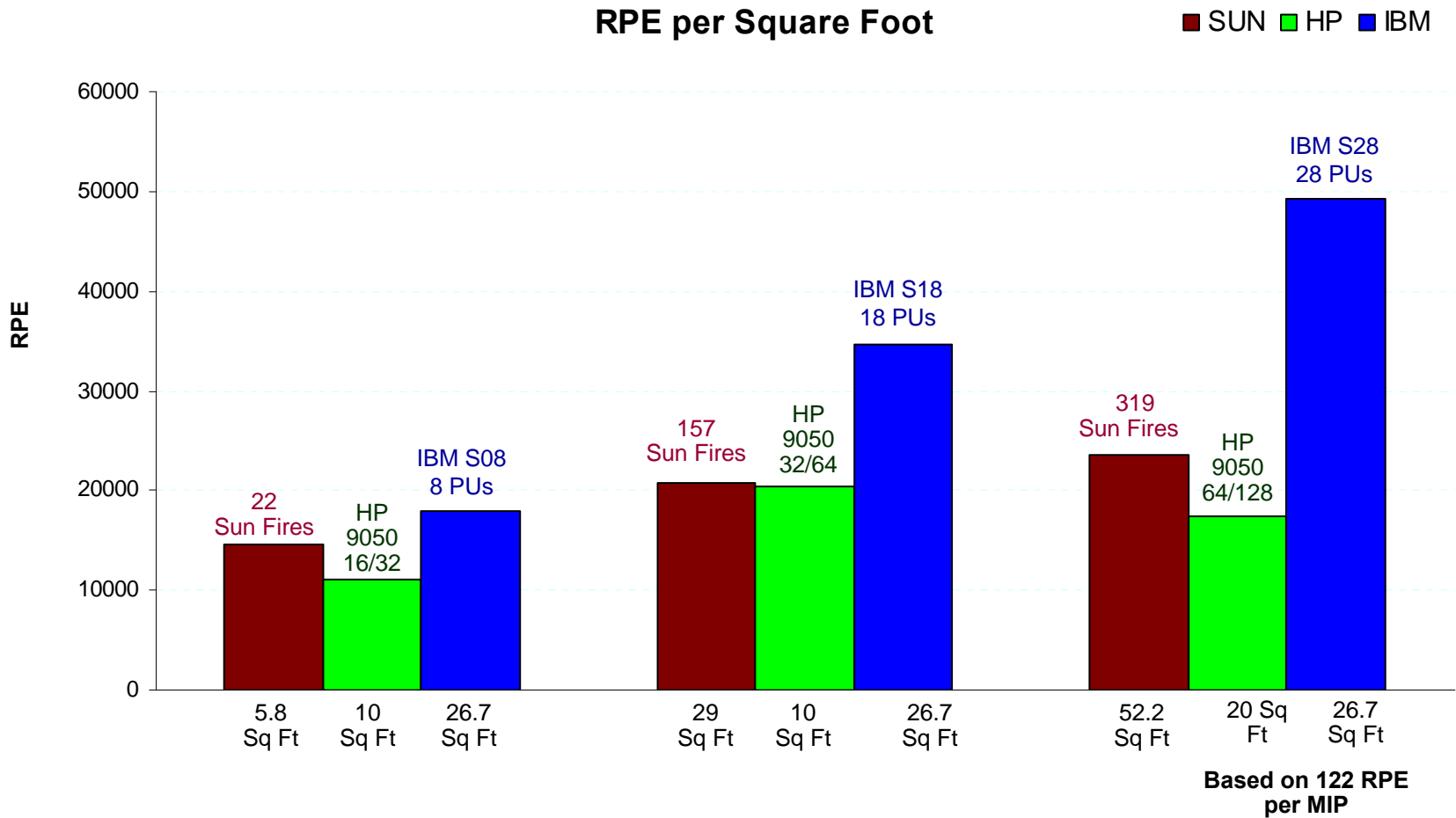= 368 Chevy Tahoes

= 9424 refrigerators

= 10,549 round trips NY to LA

= 78,753 75 watt light bulbs running 8 hrs/day

The Mainframe Also Requires a Smaller Footprint

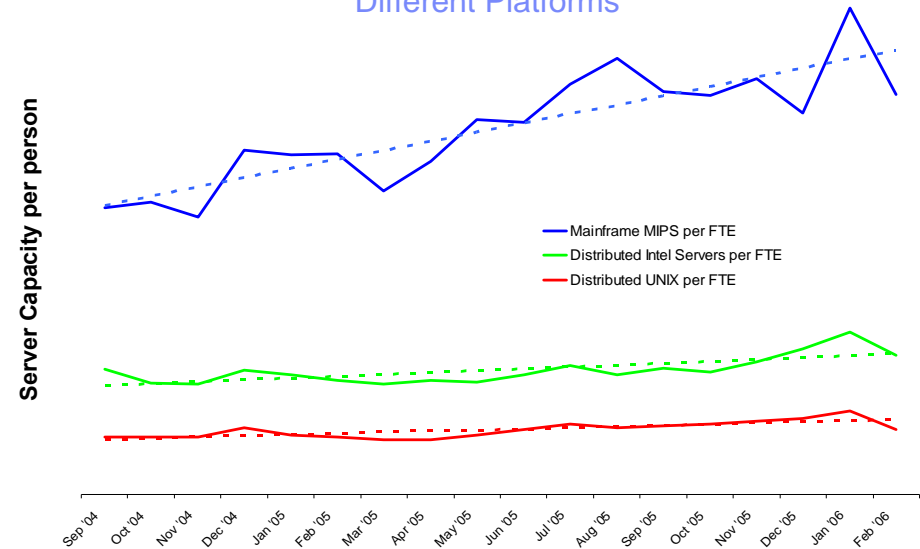**RPE per Square Foot**

Legend: ■ SUN ■ HP ■ IBM

Based on 122 RPE per MIP

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
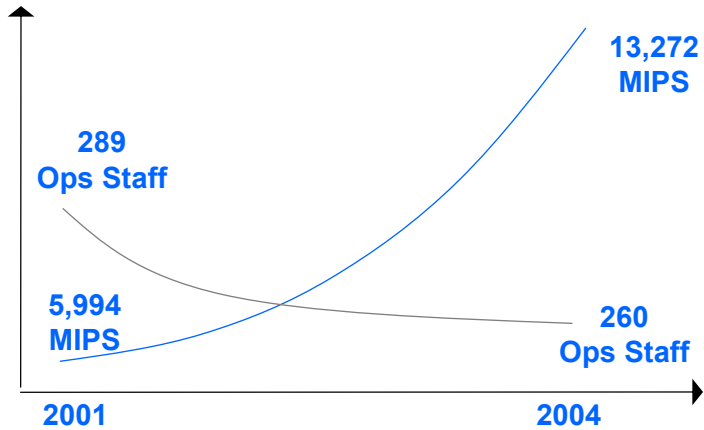
Hardware Managed Per Person for Different Platforms

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
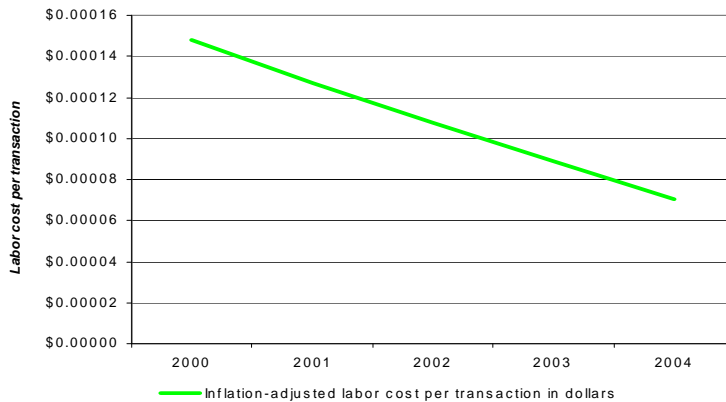
First National Bank of Omaha

	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
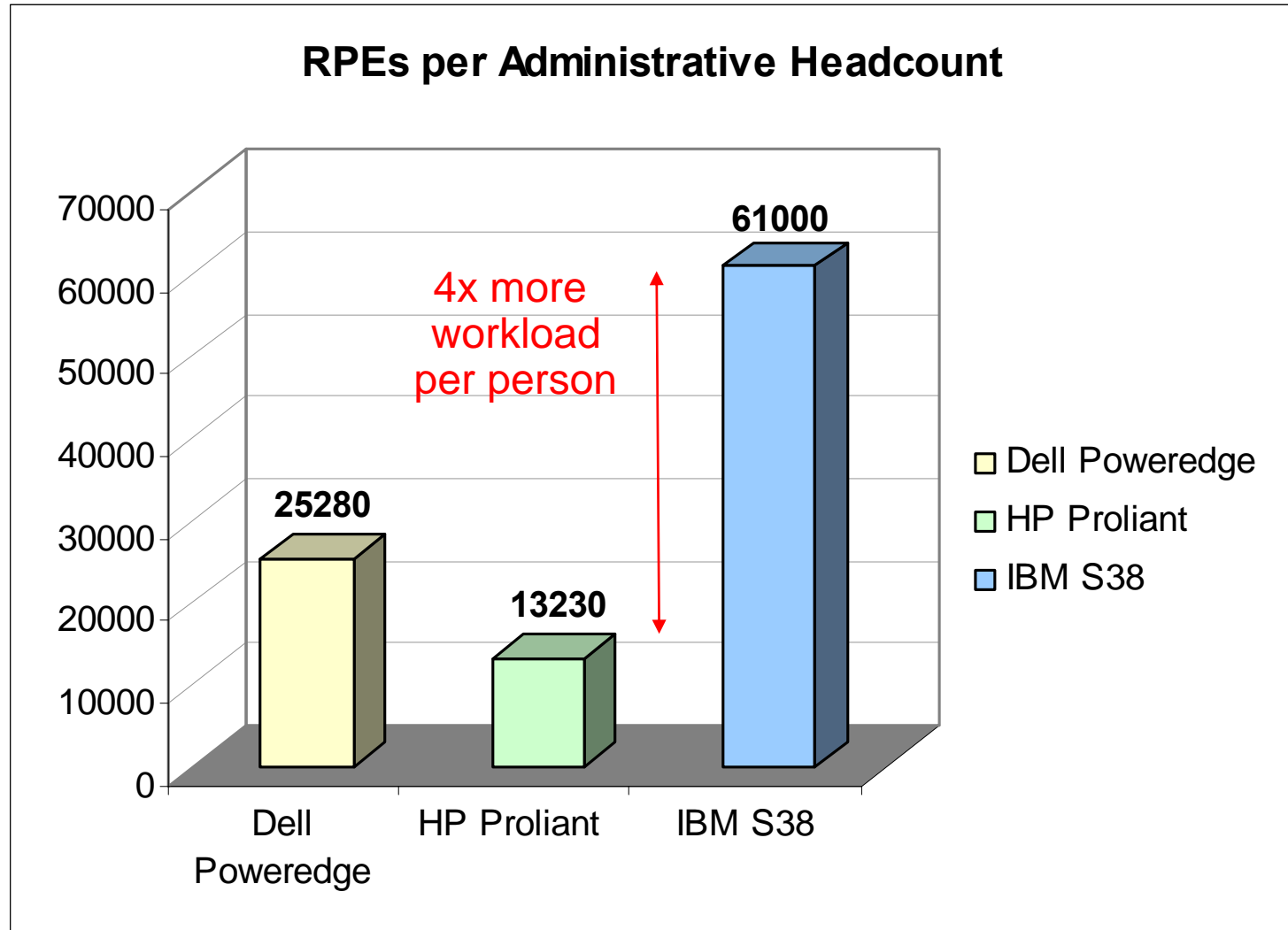
Customer Survey – How Many People to Manage Servers?

# 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**

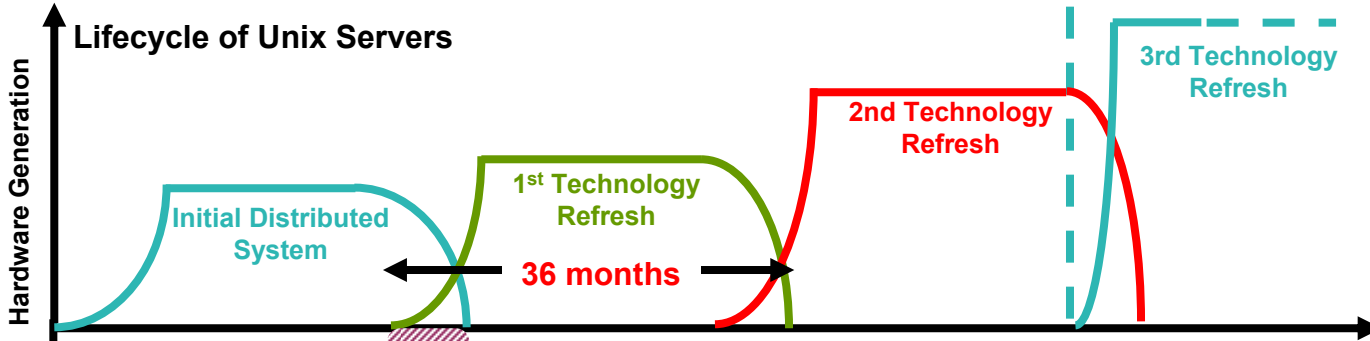Mainframe administration productivity surveys range 167-625 MIPS per headcount   (500 is typical), so…

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

Manage More Workload Per Headcount

RPEs per Administrative Headcount

- Dell Poweredge
- HP Proliant
- IBM S38

4x more workload per person

Dell Poweredge: 25280
HP Proliant: 13230
IBM S38: 61000

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

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

Lifecycle of Mainframe Generations

Hardware Generation

Initial Mainframe System

1st Technology Refresh

2nd Technology Refresh

36 months

36 months

36 months

36 months production

1 Weekend upgrading to new hardware and software levels

No need to retire the server, upgrade in place
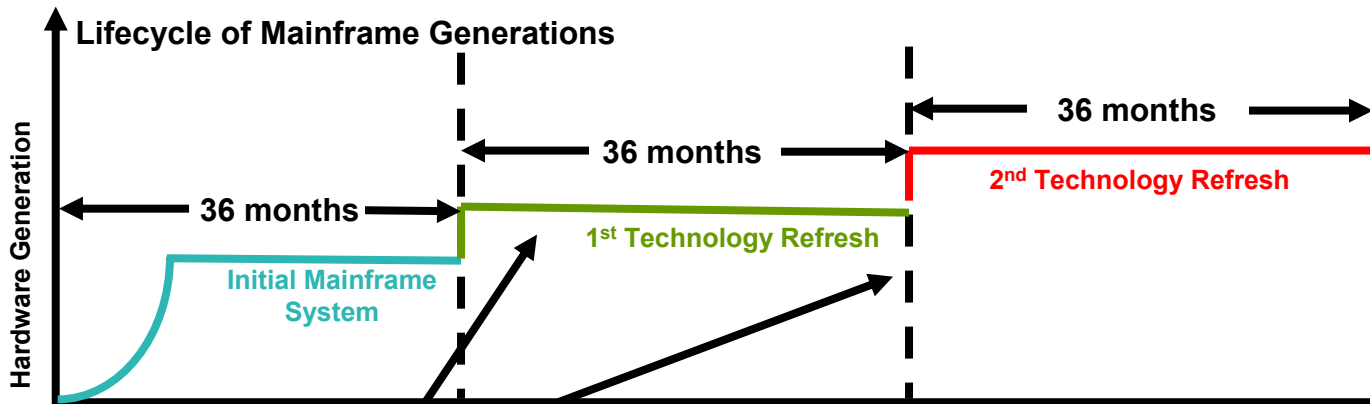
Weekend upgrades performed by IBM

Capacity on demand pricing

Fractional Availability Improvements Are Important

Example 1: Financial Services Company

- $300B assets, 2500+ branches, 15M customers
- Retail banking, loans, mortgages, wealth management, credit cards
- CRM System – branches, financial advisors, call centers, internet
- Number of users – 20,000+

	Unix/ Oracle	zSeries/ DB2
Availability %	99.825%	99.975%
Annual outage	15h 20m	2h 11m
Cost of Downtime	**$45.188M**	**$3.591M**

Sources: ITG Value Proposition for Siebel Enterprise Applications, Business case for IBM eServer zSeries, 2004 & Robert Frances Group, 2005

Financial Impact of Downtime Per Hour

| Industry segment	Cost
Energy	**$2,818K**
Telecommunications	**$2,066K**
Manufacturing	**$1,611K**
Financial	**$1,495K**
Information Technology	**$1,345K**
Insurance	**$1,202K**
Retail	**$1,107K**
Pharmaceuticals	**$1,082K**
Banking	**$997K**
Consumer Products	**$786K**
Chemicals	**$704K**
Transportation	**$669K**

Cost of a Security Breach

- **Total costs per compromised record**
  - $182 per record or $4.8 million per incident
  - Incident costs reported ranged from $226,000 to $22 million
  - Total of $148 million in costs across the sample of 31 companies

- Average customer loss was 2 percent of all customers, with some reporting up to 7%

Direct Remediation Costs $54/record

Total per Incident Cost $182/record

Loss of Customer Costs $98/record

Indirect Productivity Costs $30/record
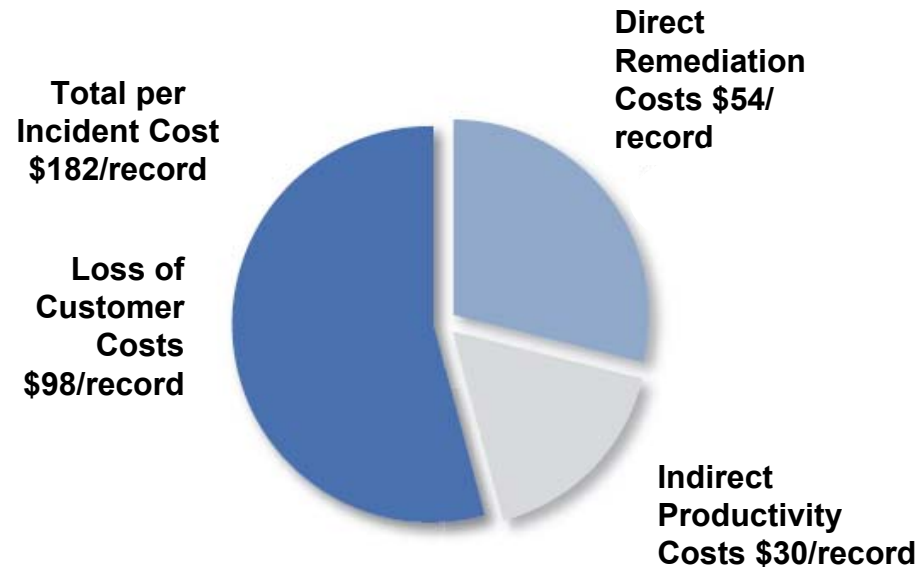
Ponemon Study: 2006 Survey Cost of a Data Breach

Charge Back Practices Were Improved Over Time at a Large Financial Institution
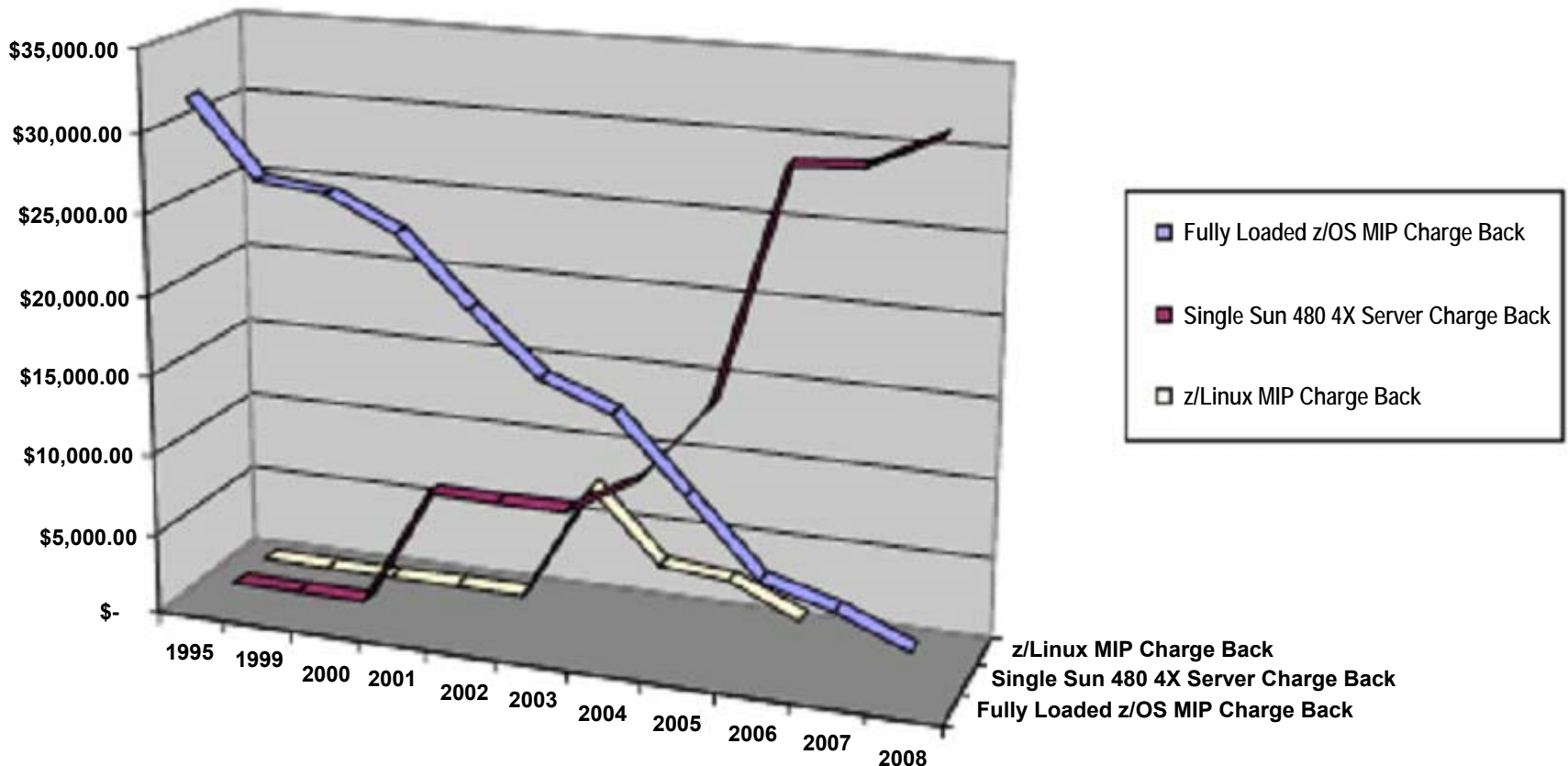
More Accurate Charge Back Can Correct Perceptions of Relative Costs

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